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Developing a Business Model for biogas liquefaction plant business

CASE: Wärtsilä Oy

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Table of contest

LIST OF FIGURES

LIST OF TABLE

LIST OF ABBREVIATIONS

CVP	customer value proposition
EBIT	Earnings before interest & tax
EBITDA	Earnings before interest, taxes, depreciation and amortization
EPC	Engineering, procurement, construction
LBG	liquid biogas
LNG	Liquid natural gas
MMBtu	British thermal unit
MR	Mixed Refrigerant
PESTEL	Political, environmental, social, technology, economic, legal
RB	Reverse Brayton
ROI	Return on investment
ROE	Return on equity
TPA	tons per annual
TPD	tons per day
SRM	Single Mixed Refrigerant
USD	USA dollar

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ABSTRACT

Increasing understanding to customer needs, creating competitive advantage, constant commercial technology innovation and biogas business environment in Europe. LNG network expands all the time around the world. This will give huge opportunity to liquid biogas business. Local business include small scale gas business and biogas producers are part of that. This research purpose is to generate the workable business model for Wärtsilä's biogas liquefaction plant business.

This study reviews the different theories in business model field and the relation between different business model components. One part of thesis is interviews which can split two different categories. First category interviews contain biogas producers. Second category interviews contain potential end customer companies in transportation and maritime sector. Interviews was excellent sources for the business model, environmental analysis and competitive analysis.

My research generates two different business model options. First business model option is licensing model. Model basic principle is to sell product licensing only to third partner. Wärtsilä offer only basic technology package, engineering support and possible life cycle service. The licensing organization will be very slender and fixed costs are minimized. Second model is inhouse model which purpose has to provide EPC turn key solutions. In nut shell, Wärtsilä will sell biogas liquefaction plant in the turn key solutions. This means that, Wärtsilä will take all responsibility about the engineering, sourcing, production, commission and warranty. Wärtsilä competitive advantage is ability to offer financial support to the customer. On that way, Wärtsilä's has many competitive advantages which helps to Wärtsilä to become market leader in biogas liquefaction plant supplier.

My research indicates that both business models are good options and the choice will depend of the company strategy direction. Better possibilities will give inhouse model which can generate more money and value to the company.

KEYWORDS: Value proposition, value generation, Business model, Canvas model, business model innovation, liquid biogas, biogas business, Gas business industry

1. INTRODUCTION

1.1. The background of the study

Value proposition is probably the most important component in business model. Nevertheless, many companies failing to define their own value proposition. Value proposition is the value what company delivery to the end customer via service or product. According to Eyring (2014:91), company's value proposition must to solve customer's problem. Solutions should be simple, affordably, accessibly or more effectively than the alternative solutions. Solutions also depending on the market. Customer needs can be totally differential in emerging markets than European markets. On the other hand, customer needs can be also quite similar. Business model will contain many different components and value proposition will collect those components together. In business model, there is three other important components. Those components are key resources, key process and profit formula. Value proposition and key resource elements competing on with differentiation. Profit formula and key processes components competing on price. Figure 1 present, how simply the business model can be.

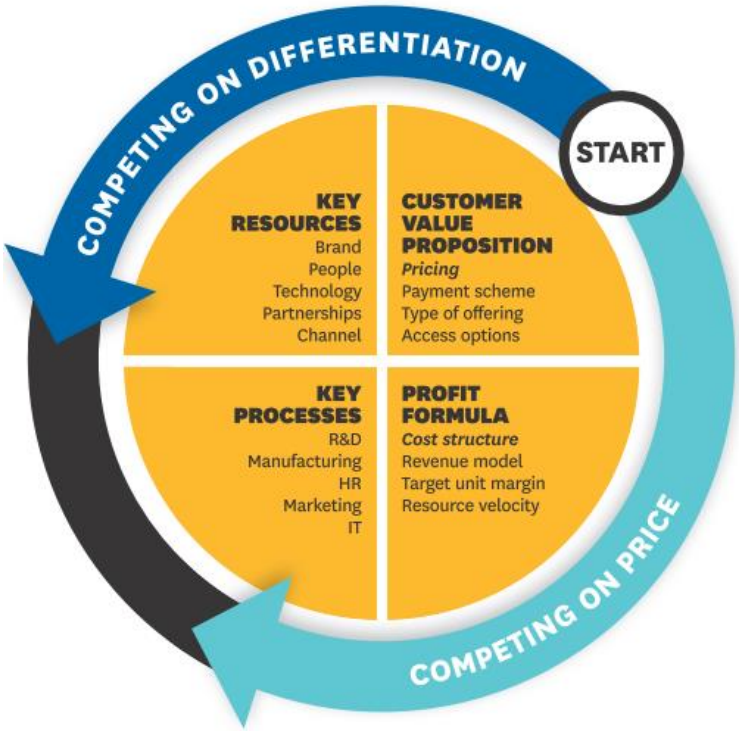

Figure 7 *Simply business model principle (Eyring 2014:93)*

According to Eyring (2014:93), business model components interaction must design to compete on differentiation and on price. Value proposition will deliver via resources and processes elements. Profit formula element define the cost structure and revenue model. Profit formula influence directly to service or products pricing.

Competitive advantage business model secret is evolution. Business model innovation is one important direction how company can develop and exploit own business model. According to Girotra & Netessine (2014:98), decision making is first step for the innovation development process of business model. To the end results will affect who makes decision, when it have made and why. Successful innovation will generate more revenue to the company with lower cost and risks.

Wärtsilä has faced new situation in gas business. Wärtsilä has made decision to exploit their business portfolio to the gas industry. Liquid natural gas (LNG) will played very important role because gas is more compact in liquid form. LNG will solve the gas transportation problem. New LNG overall strategy has been completed. In a nut shell, Wärtsilä target will be EPC turn key contractor in gas infrastructure business. Wärtsilä has a large solution tool box for the small-scale gas infrastructure. On this thesis focusing on to develop the business model to Wärtsilä's liquid biogas (LBG) business. Integration to the overall LNG business model will be difficult put not impossible.

The cost and complexity of liquefaction plants increase with the amount of impurities. Lowest cost cab be achieved with low water content, low CO2, low N2, low O2, low H2S and suitable content of heavy hydrocarbons. LBG problem is that it consists more CO2 than pipeline natural gas and less methane than pipeline natural gas. This means that bio gas needs to clean up before producing liquid bio gas.

In the world is available many different gas sources and biogas is one of these. Biogas is excellent solutions for local energy production. It is cheap and environmental friendly energy source. The best price from biogas will come in liquid form. Currently this means, that the LBG production needs heavily investments. For that reason, the LBG production is suitable in Europe because shale gas is dominant in US, pipeline gas is dominant in Russian. In Asia the markets are not ready for upgraded biogas because the natural gas is dominant. Biogas could be excellent local energy source but biogas will not solve the ground energy needs for the industry. Biogas only support the natural gas infrastructure and be a green option

Starting point to the business model development process is challenging. LBG largest problem is unknowing end customer. Who will be biogas end customer is probably the most important question in this field. Potential customer segments are many available options but political decision will influence too much today. Government's support system around the Europe control to produce electricity and heat by burning raw biogas.

Currently, the LNG/LBG customer developing all the time. European car manufacturer develop better engines. For instance, Volvo has developed new truck engine which is suitable to north road standards. Today truck's engine problem is too low output power for the gas mode. Engine manufacturer has developed gas engines to the train also. The largest breakdown will be the maritime sector. In maritime business the fuel consumptions are in next level. Local producer competitive advantage could be the local fuel source. The gas technology increases all the time in maritime business. Every large engine manufacturers have developed dual fuel engines for different power level. MAN and MAK will be the worst competitors for the Wärtsilä. When looking all newbuilding vessel projects in Europe in different vessel type, is easy to note that dual fuel engine coming a standard. All Ropax and Cruise vessel will be the dual fuel vessel because new emission regulations coming and LNG fuel is the easiest way to fulfill the regulations. Good example how the LBG infrastructure could be work, is Vaasa region. In Vaasa region have many biogas producers. Local ferry operator Wasaline could be made a new ferry investment which use LNG. Part of year fuel consumptions could be come from local LBG producers.

In the end, biogas business needs only the right players on the right table. Biogas producing business have to be attractive investment target for the investor. LBG infrastructure will developed when LNG infrastructure develop. Before that, nowdays biogas producers will not make any investment for the LBG production. After that, business will be running.

1.2. The purpose of the study and research questions

The objective of the research is to investigat the biogas business environment in Europe and investigate how potential options the biogas could be in liquid form. The research will focus on biogas business potential in Finland only. The most important question in this thesis will be, how to developing workable business model from Wärtsilä's viewpoint which will serve all core segments. The purpose of the investigate is to increase the

knowledge and understand the biogas business environment and develop the business model to Wärtsiläs biogas liquefaction plant business which fit to Wärtsilä's overall LNG strategy. Thesis will start to study the biogas environment in Finland and understand the biogas producers. Currently in Finland, many possibilities are open what to produce from biogas. End product can be raw biogas, upgrade biogas, electricity, heat or LBG. The research question is how to develop workable business model for the biogas liquefaction plant business from plant supplier viewpoint. The proposed research questions are:

1. What kind of business model or models guarantee the best results for the Wärtsilä
2. What kind of elements business model needs to contain and what those elements contain

Thesis will contain interviews from biogas producers and networks. One target for the business model is to define value proposition which based on collected data from biogas producers. On this way, Wärtsilä will understand better what the producer really need to take next step. End of thesis, target is to get two different business model options.

1.3. The structure of the study

The structure of this thesis can divide in 5 parts. First part introduces briefly the thesis environment, what is business model, what is liquid biogas and how it uses. First part presents the research questions. Second part is the theory part of business model. Purpose of the theory part is to present how many ways the business model term can explain. Theory part also present shortly couple different business model theories. Finally will present how the future business model will build and what different theories using on this business model. Third part present the empirical theories about the case studies and what kind of limitations case study method bring.

Fourth part present the business environment, result of interviews and the business model options. In business environment part will go deeply to biogas business in Finland. Enviromental analysis based on PESTEL analysis and competitive analysis based on Porter's five forces. The last part of this thesis is conclusion. Conclusion part will summarize how the results fit to the theory and how useful results are to Wärtsilä. Conclusion contain also future research and thesis limitations.

2. THEORETICAL BACKGROUNDS

Theoretical backgrounds chapter purpose is to introduce several authors business model concept and explain more deeply what are the business model elements. Business model elements help us to understand, create or develop the company's business. When planning the company's process, business model elements need to be taking into account because those elements are dependent on each other's.

2.1 Business model definitions

According to Hedman and Kalling, purpose of the business model is to describe all key components what company's business need to be successful (Hedman & Kalling 2003: 49). Every successful firm have a business model which is workable. Developers must to understand that business model is only tool for organization to understand how the company could generate the revenue at a reasonable cost. Business model present also how company could capture and create value (Gambardella and McGahan 2010: 263). Every successful business model developer understand that business strategy is less generic than business model (Teece 2010: 179).

It is important to understand that means of business model term is more different than strategy. Strategy contain long term goals and vision. Business model contain short term goals and implementation plan. According Chesbrough and Rosenbloom (2002), there are three different way how business model differs from strategy. Firstly, business model purpose is to construct the model around creating and delivering the value for the customer. Second difference is value creation for the business versus value creation for the stakeholders. Business model purpose is to create value for the customer and generate revenue to the company. Third difference is the state of knowledge. In business model the knowledge is cognitively limited which based on early successful. In strategy level the knowledge based on analytical calculations which are carefully made (Chesbrough and Rosenbloom 2002: 536).

The business model one key role is to convert technical inputs to economics outputs. Technical inputs can be for instance feasibility or performance. Business model contain value proposition, market, value chain, value network, cost, profit and competitive

strategy. Business model convert technical inputs to economic outputs which are for instance value, price and profit (Chesbrough and Rosenbloom 2002: 536).

According to Chesbrough and Rosenbloom, business model contains six different functions which are market segment, value proposition, cost structure whith profit potential, structure of value chain and mapping the company position in competitive strategy and value network (Chesbrough and Rosenbloom 2002: 533-534).

Business model definition is difficult to define because every authors have own way to understand and define business model term. Still every business model has several same elements and components what the successful model has to contain. Collect those business model together, we can see that the business model's main purpose is to find a solution how business can create and generate value for the customer and money for the company and owners. Below on the table 1 are several authors business model definitions from the different time.

Author	Business model definition
Wirtz (2001)	"A business model is a simplified and aggregated representation of the relevant activities of a company. It describes how marketable information, products and/or services are generated by means of a company's value-added component. In addition to the architecture of value creation, strategic as well as customer and market components are considered in order to realize the overriding objective of generating and preserving a competitive advantage."
Osterwalder & Pigneur (2010)	"A business model describes the rationale of how an organization creates, delivers and captures value"
Kaplan (2012)	"A business model is a story about how an organization creates, delivers and captures value"

Linder & Cantrell (2001)	"A business model is your company's logic for making money in the current business environment"
Peter Drucker (Casadesus-Masanell, R. & Ricart, J. E. 2011)	A business model answers to the questions: "Who is your customer, what does the customer value, and how do you deliver value at an appropriate cost?"
Joan Margretta (Casadesus-Masanell, R. & Ricart, J. E. 2011)	"The story that explains how an enterprise works"
Johnson et al. (2008)	"A business model, from our point of view, consists of four (customer value proposition, profit formula, key resources, key processes) interlocking elements that, taken together, create and deliver value. The most important to get right, by far, is the first."
Zott & Amit (2010)	"The overall objective of a focal firm's business model is to exploit a business opportunity by creating value for the parties involved, i.e. to fulfil customers' needs and create customer surplus while generating a profit for the focal firm and its partners."

Table 5 *Business model definition*

2.2 Business model elements

Osterwalder and Pigneur (2010: 15-51) have developed very clear business model concept which content nine different blocks. Those blocks describe the business process and give a clear answer how to make business and what functions company needs to generate profit. Osterwalder's and Pigneur's concept name is canvas business model. Canvas build the all nine blocks for one sheet which is presented in figure 2. Canvas business model elements are key activities, key partners, key resources, customer

relationship, channels, customer segments, revenue streams, cost structure and value proposition.

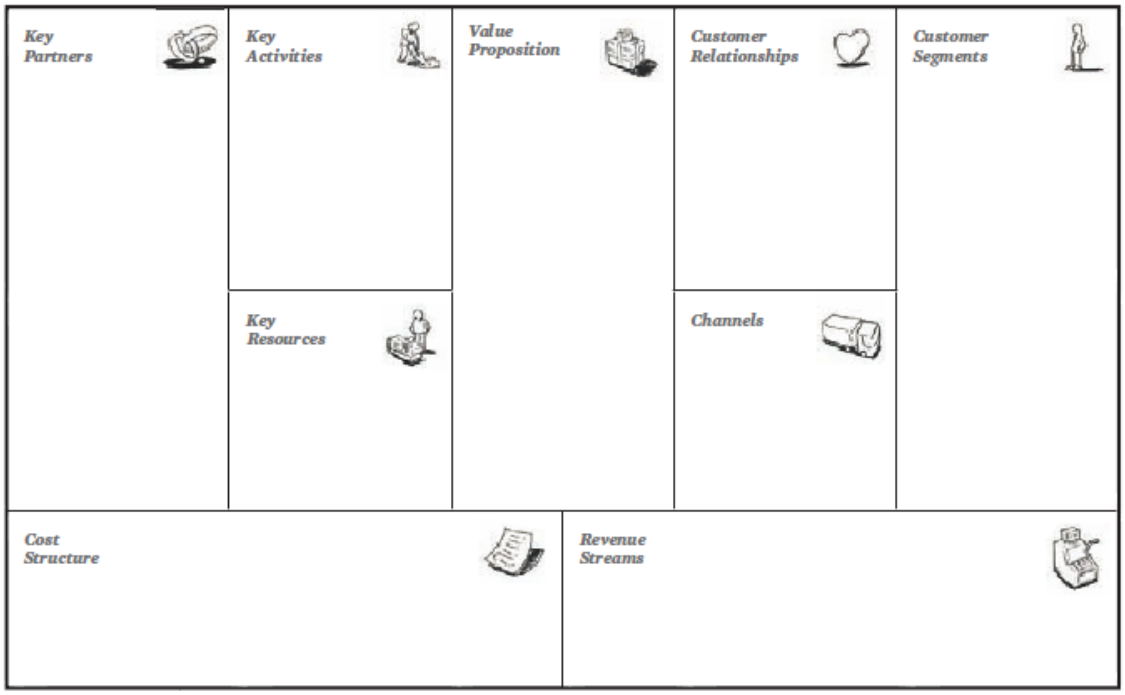

Figure 8 *Osterwalder's and Pigneur's (2010:44) Business Model Canvas concept*

Casadeus-Masanell and Ricard see the business model in different way. Figure 3 show their business model concept. The main idea is to divide the business model in two parts which are choices and consequences. The choices part is company's internal choices what they need to make and those choices focus on for instance pricing, sales, operation. Choices part divides in three different main parts. First part is policy choices which determine the company's all key actions. Second part is asset choices which determine the tangible resources what company needs, for instance manufacturing facilities and equipment. Third part is governance choices which determine the company's ability to make right decisions over the other two main parts and how to arrange it. The consequences can be flexible or rigid, Flexible consequences means that company can respond quickly when the previously mentioned choices changes. Rigid consequences are opposite for flexible. Rigid consequences positive side is that it is difficult to imitate because it takes time to build similar governance systems (Casadeus-Masanell & Ricard 2011:103).

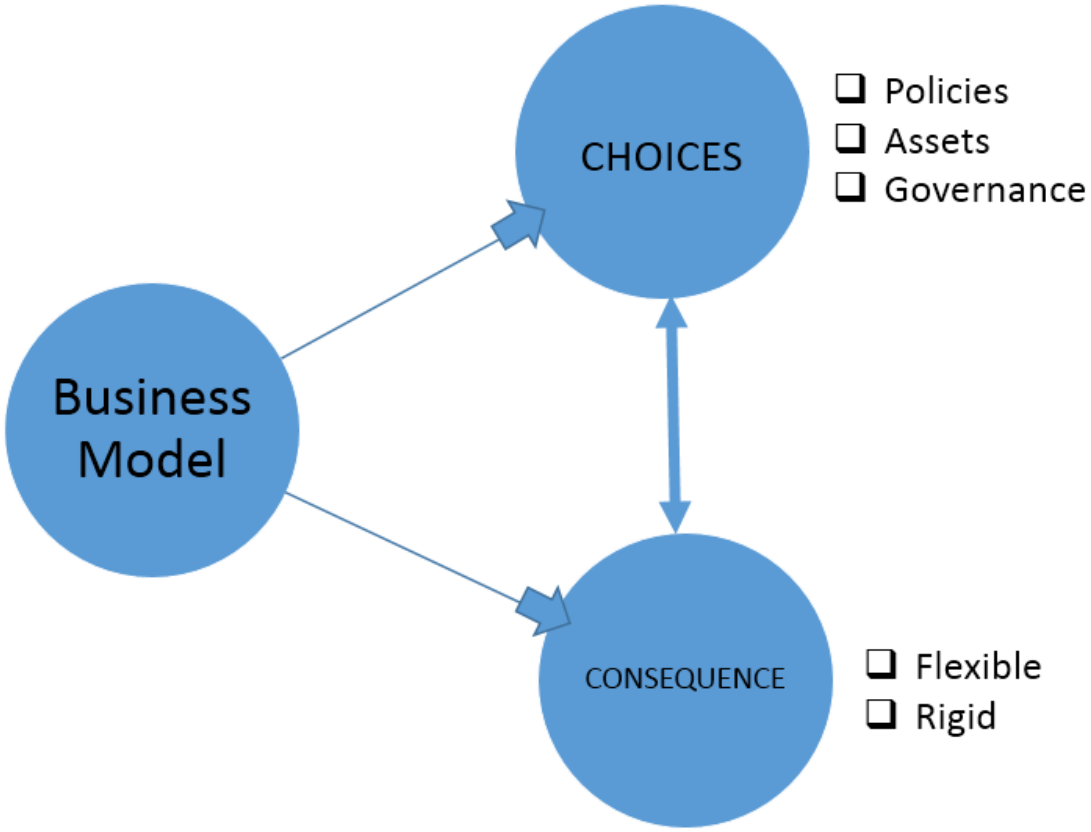

Figure 3 *Casadesus-Mansell & Ricart (2011) Business model concept*

Johnson et al (2008) developing business model which consist same elements than Osterwalder's and Pigneur's canvas model. They see that successful business model will consists four following elements which are key processes, profit formula, customer value proposition (CVP) and key resources. All of those four elements are linked together and all kind of alternation influence directly to the other elements (Johnsson et al. 2009: 52-54).

According to Johnsson et al (2008), CVP is the most important elements and precision is the most important attribute of CVP if company wants to be successful. Precision describe how perfectly it fits to the customer's needs. Company's need to generate value for the customer. Same time they need also generate value for itself. Profit formula main function is to describe how company capture value for itself. Key processes and key resources describe the way how company generate and deliver the value proposition to the end client (Johnsson et al. 2009: 52-54). Kaplan has also similar ideology than Johnsson et al. because value delivery, value creation and capturing value are importance for Kaplan's business model (Kaplan 2012: 17).

According Itami and Nishino (2010), Business model can divide into two different parts which are profit model and business system. Business system part describe how the business is designed and describe the products or services process from company to the end customer. Profit model describe how the business will generate profit to the company. For instance, profit model analyzing company's ability to increase their sales or reduce total costs. Profit model purpose is to define company's difference between their competitors. Usually profit model is also visible. Reason for that is the profit model due the direct links to the company's bottom line and it is what outsiders can detect. Business system is usually less visible but often more important. Designing the business system, the company need to determine three issues:

1. What makes itself and what outsourcing?
2. Internal phase: How the in-house system can organize? (internal)
3. External phase: How to control and manage activities of trading partners?

Itami and Nishino business model key idea is to be better than competitors and learning more about technology, their customer reaction etc. Business model content two factors which are profit model and business system model. Idea is that model will contain both elements on the business model. Profit model and business system is input data and output data will be delivery system and learning system. Delivery system can divide into external and internal (Itami and Nishino 2010: 364-366).

Wirtz has developed business model which consists same type of elements as Osterwalder's and Pigneur's canvas model. According to Wirtz, value creation is the key link to the all other business model elements. Wirtz's business model main name is partial models which contents of three components. Those components are value-added, customer & market and strategy components. Synergy and linkable between all of these components are important because components cannot operate independently. The role of interaction and balance between components are important to get sustainable and profitable value (Wirtz 2011: 110-148).

This research will base on Osterwalder's and Pigneur's canvas business model. Osterwalder's and Pigneus's business model canvas base already fit to the Wärtsilä's overall LNG business model. Additional elements are not necessary to develop in this study. Canvas Business model contain nine different elements. Other researchers have

similar elements on their business model concepts. For that reason, some elements contain also other authors' theory.

2.2.1 Partners block

Every company needs business partners because without partners company cannot survive on the business environment. Now days, companies have a own partner network which integrate companies together. Key partnership block describes the what kind of key partners firm will need in business model. Usually companies have several partners which are divide into different level of partnership. Value creation or cost savings influence to Company's motivation to create partnership with the other companies. Key partners block describes the company's whole network of suppliers which they needed to value creation process. Part of those partners are usually cornerstone for the company's business model. Company will develop their partnership and create different alliances to optimize their business process. For instance, the purpose to create alliance is usually reducing risks, outsourcing or acquire more resources (Osterwalder and Pigneur 2010: 38-39). Key partnerships can divide into four types:

1. Strategic alliances between non-competitors
2. Cooperation between competitors
3. Joint venture, which target is to develop new businesses
4. Buyer-supplier relationship

Is exisiting many different reasons to developing partnerships. Company tries to reduce cost, risk, create more value or acquire more resources. Reduce cost or create more value is usually key reason to develop partnership. Purchase functions typically favor solid partnership which affect directly to manufacturing and cost structure. Partnership is solutions to use resources effectively (Wirtz 2011: 136-141; Osterwalder and Pigneur 2010: 38-39).

Control and reduce the risk have always important role in company's day live. Reduce and control the risks can be also the main driver to form partnership. Currently, the business environment in every field is very competitive which influence to company's desire to form long term partnership because partners have usually direct link to value creation (Osterwalder and Pigneur 2010: 38-39).

2.2.2 Resources block

Company's key assets have defined in key resource block which affect workable business model. Key resources can divide into four main assets which are physical, financial, intellectual and human. Key resources also link directly to the key partners because company can own or leased resources. When company leased resources from the other company, partnership between those companies have created. Physical assets can be buildings, machines, manufacturing facilities, systems and distribution networks. Intellectual assets can be patents, partnerships, brands, proprietary knowledge and customer databases. Financial assets are cash, lines of credits and stock options. Stock options are good bait for hiring key employees for the enterprise. Last assets are human which contain the key people who create the value for the products or service. They have also needed knowledge what corporation require in value creation process (Osterwalder and Pigneur 2010: 34-35).

In value creation process, essential issue has generating and balancing available resources because the company's funds are limited. This is also one way to balancing company's cash flow. Company's needs to find out the best combination between different resources which create the most value for the company and customer. The role of investing, playing important role in value creation process because company need free cash flow to investing financial resources for the future which guarantee value process continue in future. This means also that without right people and right product development investment, company cannot guarantee the sustained value creation (Achtenhagen, Melin & Naldi 2013: 436-437).

Enterprise's need to define they key resources because it affects company's value propositions. If company can create business model which is unique and difficult to copy, it gives huge competitive advantages for the company. Company's key resources can be combination between external and internal resources which are tangibles or intangibles. When the company's key resources are identified, they can develop those resources and improve the competence (Wirtz 2011: 118-120).

2.2.3 Activities block

Key activities will define the different key things what companies must to do be a successful. Key activities block can consist three different parts which are problem

solving, production and platform or network. Key activities dependent of what is company's industry sector. For manufacturing companies' production activities is dominant in their business model. Typically, production activities content designing, production, assemblies, commission and delivering activities. Problem solving activities are typical for consultant business. They need knowledge management and ongoing practice. In network or paltform part typical activities are platform management, platform promotion and service provisioning (Osterwalder and Pigneur 2010: 36-37). Key activities can see also on the other way. According Johannsson business model, the key activities are different process (Johnsson et al. 2009: 54).

Activities can see also the bases for company's critical capabilities. Key activities are essential in the value creation process (Achtenhagen et al 2013: 427-442). Business activities depend on what kind of business company can do. Service business and production business needs many different activities such as organizing, planning, monitoring and management. From efficiency and financial viewpoint these are important controlling activities.

According to Kaplan (2009:21-29), key activities part purpose is to describe the all actions what company need to do during the value delivering process. Delivery is also related to company's capabilities. Some of actions have a key role and other one have a supportive role. The company's operations model can divide into two smaller parts which are key enablers and core capabilities (Kaplan. 2009: 21-29). Process are one way to explain business model's important activities (DaSilva & Trkman 2013).

2.2.4 Value Proposition block

Value proposition part in business model is the most important block because it connects all blocks together. Value proposition block describe the value what company's product or service create to the end client. Company's value proposition will be answer for the client's question: How to solve customer's problem? (Osterwalder and Pigneur 2010: 22).

Customers have different attributes. Other attributes are more popular and important than other attributes. Customer purchase decisions based on favoring and the most important attributes. Attributes can divide into two different categories which are qualitative or quantitative. For the company, the key is to find out what attributes are appealing to company's customer segments. If company cannot compete with the product's or

service's price, the company can compete with quality propositions such as performance, design and brand (Osterwalder and Pigneur 2010: 23-25).

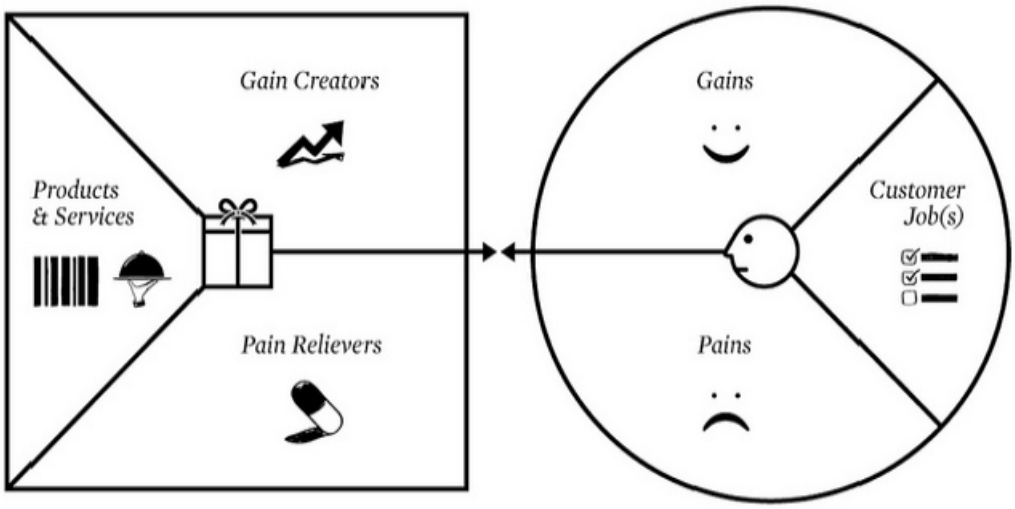

Figure 4 *Value Proposition Canvas by Osterwalder et al. (2014)*

From value perspective understanding the customer needs is the most important task. When company start to think their value to the customer, their need to think how product's or service's impact to the customer and whole purchasing process. Company has available many different tools to define and design company's value proposition. One possible option is to use Osterwalder et al. (2014) Value Proposition Canvas model. Basic idea of the model is to scan all potential customer values. After scanning process, company's have to choose the values where they will focus. First step is to describe the customer jobs, pains and gains which are the model right side. Customer job tell what customer tries to get done. Pains describe different problem what customer have to get job done. Gains describe the customers' benefits and what they want. The model left side is the value map. Value map contain three levels which are products and service, gain creators and pain relievers. Starting point for the Value mapping process is to describe what product or service company can offer to customer and how company product or service relieves customer's pain. Gain creators describe how company's service or product is useful for the client and how customer will benefit from it. Figure 4 present the Value Proposition model.

Usually a company's value creation process has explained through the Michael Porter's value chain theory. The value constellation is a different perspective which contains all partners through the value creation process. Same time the model minimizes focusing on

the firm itself. In value constellation process all components have various roles and those work together to increase customer value. Components can be coordinator, general partner, distributor and supplier (Wirtz 2011: 154-156).

According Demil and Lecocq (2010: 227-228) static approach is one possibility to produce value to customer. In static approach the business model is a blueprint which fulfils all important functions on the business model. In other word, static approach will build bridges between all important components which create value to the customer. The other possibility is transformational approach where business model has to be ability to create new innovations which change the industry. Important question in transformational approach is how to change it?

Situation on the market must to take into account in value proposition creation. Today the competition is tight. If the service or product is new and innovative, straight competition may intervene. In the value proposition creation process, analyzing the potential customer segments and competitors is important task. The results of analyzing process will expand the company's knowhow and they can achieve competitive advantages (Wirtz 2011: 127-129, 169-170).

At the same time the value innovation should increase the client's value and decrease the cost in blue ocean strategy. In the other word, the blue ocean strategy' value innovation means differentiation. Figure 5 present how value innovation is created.

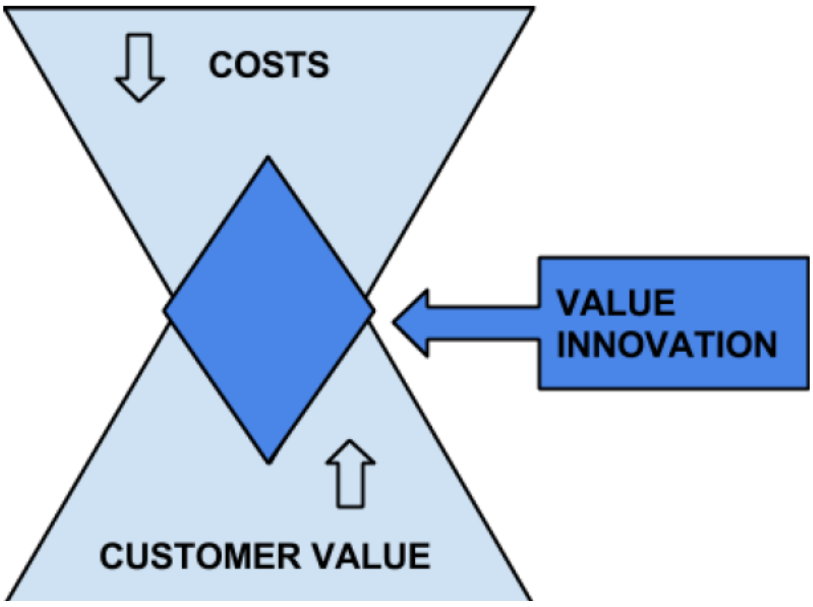

Figure 5 *Value Innovation proces by Kim and Mauborgne*

According to Tuulaniemi (2011) customer value contain various elements which are brand, price, features, desing, saving accessibility, customization, riks reduction, novelty value and easy to use.

2.2.5 Customer Relationship block

Customer relationship block describes the type of relationship between company and client. Level of customer relationship depends on the type of service or product. Osterwalder and Pigneur split the customer relationship into six different types which are self-service, dedicated personal assistance, personal assistance, communities, automated service and co-creation. Customer relationship is important from client acquisition and customer retention viewpoint which are also driven forces in this business model block (Osterwalder and Pigneur 2010: 28-29).

Personal assistance relationship is based on human interaction. Customer has personal assistance which helps customer during and after the sales process. Dedicated personal assistance is deepest and the most intimate relationship type and more specific than personal assistance. In this type of relationship, the client is individual and relationship has developed over the long period. Self-service relationship based on customer service himself. In this type of relationship company has not direct relationship with customers. Automated service is almost same than self-service but customer use automated process (Osterwalder and Pigneur 2010: 29).

Communities are easy way to the company to keep touch to the customers. Community basic idea is to establish group where company's product or service users can exchange knowledge and solve the problems. Companies can also understand better their customers if company exploit information which coming from community members. Co-creation relationship means that company creates value with the customer. For example, customer writes the reviews which generate value to the other product users (Osterwalder and Pigneur 2010: 29).

Relationship management is important task and typically companies' have some kind of customer relationship management in business model. It will define how company has organized the relationships between company and customer. Relationship activities depending on the customers' buying behaviors (Wirtz 2011: 152-154). Company's need

also thinking very carefully why customers buying their product or service and what customer want. Same time company have to thinks what customers' expect to relationship because it will influences the type of relationship what company offer to customer (Parviainen 2008: 144-156).

2.2.6 Customer Segments block

From company business viewpoint, clients are the most important part because the firm lives from them. Without profitable customers, company has not ability to survive in future. For that reasons, company's must to categorize the different customer segments. Those segments describe the different type of customer's what company have. Customer segments helps to understand the needs what customer have and build the business model to satisfy the best way customer needs. Segments allocation can base on common behaviors, common needs or other attributes. Usually business model contains one or several small or large Customer Segments. Top managements need to make decision what segments company serve and what segments company ignore (Osterwalder and Pigneur 2010: 20).

Number of segments in business model following the size of company and markets. Typical markets segments are niche markets, mass markets, multi sided markets, diversified market and segmented markets. In the mass markets the business model focus on only mass and business model based on large volumes. The value proposition, customer relationship and channels focus on only one large client category. Niche markets are opposite to the mass markets. In niche markets the customer are specific small group with a specific requirement. Company's job is to fulfill the requirements and satisfy a customer. (Osterwalder and Pigneur 2010: 21).

Segmented markets content slightly different needs and problems than other segments. Inside the markets are different segments which have different problems and requirements. In such markets business model need to categorized different customer segments and build the model serve those segments. In diversified markets, the business model purpose is to serve two different client segments and both segmetns have very different puzzel. Last market is multi sided markets which means that business model serves two or more interdependent customer segments (Osterwalder and Pigneur 2010: 21).

Sometimes the problem is customers' unknow needs. In such situation, the company creates demand and offer totally new and different product or service than competitors and gets a competitive advantage. In other word, such markets can define like a blue ocean in blue ocean strategy (Kim & Mauborgne 2005: 15-30).

Searching a new markets and potential clients, the blue ocean strategy theory recommends redefine the all client groups. This will give a totally new market spot to the company. Starting point for the searching a new customer coming, when purchasing power stop to increase or staying on the same level. Generating more revenue in the future, company must to find out hidden demand on the market. Those demands are company's potential future customers. Hidden demand group is noncustomers. Noncustomers are split into three different parts which based on customers' ability and willingness to purchase. Typically, customers belong soon to be clients or unexplored clients (Kim & Mauborgne 2005: 127-142).

In service business model the customer role is closely to value creation. Company have to segment their customers into different groups by their characteristic. Combining customers' behaviors and profile, company can identify business model requirements what they offer to customers. Business types influence what kind of characteristic business will contain. Business to business and business to consumer contain various characteristics (Wirtz 2011: 125-127,152-154).

2.2.7 Channels block

Channels block define the company's way to communicate and process to delivery the value proposition to the customer. The most important channels are communication, distribution and sales because those activities are company's interface with customer. Channel block contain five different channels phases which are evaluation, awareness, delivery, after sale and purchase. Awareness purpose is to raise up customer's knowledge about the company's product or service. Evaluation purpose is to help customer to evaluate and understand company's value proposition. Purchase purpose is to allow customer to purchase company's specific product or service. Delivery purpose is to deliver the value to the client. Last step is after sales which purpose is to provide support service to end client (Osterwalder and Pigneur 2010: 26-27).

Channel design foundation is to find out the right way to reach their customer segments and integrate best total solution. Channels have to be cost efficiently but also integrate

customer routines. Usually company use partners. On the other word, company's channels type decision based on financial issues. Meaning of channels is important to understand because unaware customer will not buy the company's products or service even it would be the best solution (Osterwalder and Pigneur 2010: 27).

2.2.8 Cost Structure block

All-important costs have collected to cost structure block what the business model operating generate. Naturally every business model should try to minimize the cost and in some business model the low-cost structure is more important than other. Cost structure can divide into two main categories which are value-driven and cost-driven. Typically, business models purpose is to find out the balance between value driven and cost driven. Cost-driven business model's purpose is to minimize the costs. Structure of the cost content low price value proposition, extensive outsourcing and maximum automation in value creation process. Value-driven business model purpose is to generate the best value to the client. Cost structure content premium value proposition and personalized service (Osterwalder and Pigneur 2010: 40-41).

Pricing is one key component which influence to the business model and cost structure block. Price difference between low cost business model and full-service business model divide potential customer. Operating in low cost business world, cost accounting paly huge role and company' have to reach the target customer numbers (Flouris & Walker 2005: 5-6).

Cost structure contain also other typical characteristic which are variable costs, fixed costs, economies of scope and economies of scale. Fixed costs are same all the time and does not depend on the volume of production. Variable costs depend on the volume of production. Economies of scale are cost advantage when company produce large number of products. Economies of scope are cost advantage when company use large amount of operations (Osterwalder and Pigneur 2010: 41).

Cost structure can also think in other way. Johnson et al. (2008) combine the cost structure and revenue stream together in their business model. Profit formula starts the calculation process from customer viewpoint. Company purpose is to find out the suitable prices which customer is ready to pay. When company find that price, they know how high variable and fixed costs can be. After that company can set the profit margin (Johnson et al 2008: 53-55).

Blue ocean strategy based on a similar approach than Johnson business model. Company needs to find out the suitable price which customers are ready to pay. This is easy when company know clearly customer's benefits. After that company can draft the cost structure and how much the product or service production may cost for the company. This set also strategic price for the product or service (Kim & Mauborgne 2005: 114-145).

The value creation process cause costs for the company. Costs are not only for financial planning. In manufacturing the costs are good indicators which give lot of information about developing areas and what kind of saving opportunities manufacturing contain (Wirtz 2011: 141-143).

Costs have also direct connections to the company's profitability. The level of costs can vary in company's cost structure because company's value proposition, quality requirements, strategic choice and synergies influence to the cost structure. Previously mentioned cost issues effect also to the fixed costs (Wirtz 2011: 264).

2.2.9 Revenue Stream

Revenue stream describe the cash flow from different segments by generating the company. When company knows successfully answer what value each client segment is willing to pay, firm can generate revenue streams from every client segments. Company has usually variable streams and pricing strategies for different services and products. Revenue streams can divide into different categories from fixed price to dynamic methods. Each possible stream contains different variable (Osterwalder and Pigneur 2010: 30-33).

According to Girotra & Netessine (2014:98), business model is a set of key components which earns its revenue to the company. Key of the business model innovation is to decrease the costs and catch revenue to the company. Successful innovation is to balance between costs, risks and revenue.

Company's product or service will define the type of revenue stream. Revenue stream type can be indirect, direct, independent or transaction-dependent. Usually the company have revenue stream strategy which defines the different revenue types what company have, for example fees and provisions. The revenue stream should be generated from all segments which are company, customer and suppliers. From selling price viewpoint the

customers' willingness and capacity to pay is the core when company determines the right selling price of product or service (Wirz 2011: 129-133).

Profitability is the most important issue when controlling costs and revenues. Profitability is also part of management tasks to understand the company's financial problems. When analyzing the company's portability, there are few key performance indicators. Like business model prove that revenue affect to strategy and customer value proposition. Company can focus on high quality brand when price is high but quality is excellent or price-focused brand when the price is low and quality is good. Company can also focus differentiation (Wirtz 2011: 262-264).

Overall profitability is the base for the company's business if they want to continue their business operations. There are a few indicators which measure the company's profitability and return on capital. Compnay's profitability can calculated with gross profit, EBITDA, EBIT, net profit and financial profit. Return on capital can measure with return on assets, ROI and ROE (Yritystutkimus 2011: 60-65).

Gross profit is good indicator for wholesale and retail trade. Operating profit (EBITDA) tells company's operating results before depreciation and financial items. Company's operating profit margin can compare only with the same industrial companies. In industry, the EBDITA margin should be 5-20%. Equation 2.1 and 2.2 show how EBITDA is calculated.

$$Operating\ profit\ (EBITDA) = Trading\ profit\ (EBIT) + depreciations\ \&\ reduction\ in\ value \quad (2.1)$$

$$Operating\ profit\ \% = (Operaiting\ profit\ \div Net\ sales) \times 100 \quad (2.2)$$

Trading profit (EBIT) tells how much actual business revenues are left before financial items and taxes. Trading profit margin (EBIT %) is suitable for monitoring development of individual enterprise, comparison companies in same industry area and comparison companies between different industry areas. Trading profit margin is presented in equation 2.3.

$$Trading\ profit\ \% = (Trading\ profit \div Net\ sales) \times 100 \quad (2.3)$$

Next good profitability indicator is Net profit which describes how profitability the business is. Company's business is profitability if Net profit is positive. Net profit and Net profit margin are presented in equation 2.4 and 2.5.

$$Net\ profit = Trading\ profit + Financial\ income - Financial\ charges - Taxes \quad (2.4)$$

$$Net\ profit\ \% = (Net\ profit \div Net\ sales) \times 100 \quad (2.5)$$

A break-even point is good start when company thinking what would be a good selling price for product or service. Break-even point describes the point when company's business start to make profit. The break-event point equation is presented in equation 2.6 (Tyni et al 2012: 112).

$$Break - even\ point = \frac{Fixed\ costs}{Gross\ margin\ (Sales\ price - variable\ costs)} \quad (2.6)$$

Fixed cost describes product or service fixed costs, variable costs describe the product or service variable costs, Sales price is product or service selling price and Gross margin is product or service gross margin.

Return on investment (ROI) is also good indicator for company's revenue stream calculation. ROI main idea is to evaluate and compare the efficiency of different investments. ROI can evaluate how efficiency the investment is. Second option is to compare different investments. ROI take a position on what is profitable investment (Tyni et al: 121) (Flouris & Walker 2005: 9).

2.3 Business model development

Business model development process is important task in every companies. Business environment change all the time. Companies must to integrate to the new environment fast as possible. For that reasons, the business model development is important for every companies. In theory are many different ways to develop business model.

Osterrwald and Piguer call business model development process for "ideation". Ideation purpose is to collect lot of data and different ideas together. People need to think out of the box. After that, all ideas writing down on the paper. When process continue, Ideation

goining narrow and in the end, is only few viable ideas. Osterwarl and Piquer core idea is put to group think out of the box. The group has other mission which is viewpoints. Idea is to bring lot of different viewpoints together. It is important to understand that this is very early phase business model development. Purpose is not to copy competitors or analyses other business model (Osterwalder and Pigneur 2010: 30-33).

Innovation is a one key word in business model development world. Every business model purpose is to find out the right business model for new technology which make possible to commercialize it. In that way the technology will generate value and profit to the company and owners (Chesbrough 2010: 354-363).

In blue ocean strategy, the starting point to the business model developing work is creating value innovation. Idea is to create product or service to the new niche market and will makes irrelevant competition situation. In this case, benchmarking the other competitors is useless. Idea is not to create new technology but utilize it a new way which create value for the customer (Kim & Mauborgne 2005: 12-18).

Like I mention before, innovation work is difficult for the companies and many fail to developing innovation business model. Kaplan has done research and management is the largest reason for the failure. Today the business environment is fast which make impossible to follow same business model but still companies not want to change a new one. Companies see that innovation will be more risk than opportunities. Companies see also that change the business model, it endangers the current business model (Kaplan 2012: 40-49).

According to Wirtz, after the ideation process follow the feasibility study. Feasibility study idea is to describe the current market situation, operating industry, business environmental situation and competitive analysis. Feasibility study gives more data for ideation and further developing work. Purpose of collected data is to describe a future business environment and found out the key drivers which affect to the business in future. Typical tool for competition analysis is Porter's five forces model (Wirtz 2011: 198-202).

According to Hesso, deep and realistic feasibility study guarantee the success for the company. Business environmental analysis is important and PESTEL analysis is good tool for that. PESTEL analysis contain economic, political, environmental, socio-cultural, legal and technological viewpoint. All components are important in analysis but for example political environment affect to the decision making (Hesso 2013: 34-46).

When ideation process is done and feasibility study support the ideation process' results, decision makers can see overview of all possible business model options. On that way, the developing work in early phase can convert into concrete proposals. Next helpful step for decision makers is visualization of business model. Visualization help to understanding the business model logic in large picture. Business Model Canvas is helpful tool for visualization. Canvas helps to see overview of business model and what kind of elements the business contains. Canvas also show how the business model create the value to the client and is it profitable. Canvas building blocks also show if there is some mistakes (Osterwalder and Pigneur 2010: 160-167).

Independent business model can be successful idea. When take External environment into account, the business model can be very weak. In creation process the deep external environment analysis need done. External environmental analysis is much mode deeper than environmental analysis in feasibility study phase. External environmental analysis purpose is to describe the different customer segments, customers' needs and bargaining power. External environmental analysis contains also competitive analysis. Competitive analysis purpose is to describe all competitors, substitute products or services and

Business model innovations are important issue for the companies but very difficult to achieve (Checbrough 2010:362). Companies need to developing business model whole time because speed of everything increasing. Design cycles and product life cycles are shorter. Second business model innovation is competition. Currently, competition is in high level and coming from unexpected direction. Third business model innovation trend is disruptions from other business models. Disruptions means that other business model provide better customer experience (Cliffe 2011: 94).

There are many reasons why enterprise's business model get in trouble. There are some signs which tell that troubles are coming. First clear sign is smaller improvements. If employee have smaller ability to enhance the companies offering, that is clear sign. Second clear sign coming from customers. New possible alternatives increase which are acceptable to customer. Third sign show up in enterprise's financial numbers (Cliffe 2011:94).

Technological innovation can be competition advantage but it does not automatically guarantee economic or business success. The core element of business model design is to capture value with technological innovation. Business model need to take into account

two different phase in product development process which are go to market strategy and capturing value strategy (Teece 2010:183).

Below are table 2 where is describe key questions to create and develop the business model.

Block	**Key questions**
Partners	What kind of partnership our business need? Who are our key partners and suppliers? How do we manage sales and purchase operation?
Resources	What are our key resources from value proposition viewpoint? What are our physical assets? What are our intellectual resources? What are our human resources? What are our financial resources?
Activities	How company create value proposition to the customer? How company reach markets? How company maintain customer relationship? How company manage company's distribution channels? How company manage company's revenue streams?
Value proposition	What value company delivers to the customer? What are the main benefits for the customer? What is the solutions for the customer's problem? How we solve customers' problem? What customer´s needs company`s product or service satisfy? How company's product or service increase customer's profit How company's product or service decrease customer's risks
Customer relationship	What type of relationship our customer segments want? How we retention our customers and organized it?
Customer segments	What are the most important segments for company business? Primary customers What type of segment our business model content? What needs our customer segment have?
Channels	How company can raise awareness about company's products or service or both? How company can help the customers to evaluate company's value proposition? How company allow customers to purchase company's product or service or both? How company deliver a value proposition cost efficiently to the customer? How company organize the after sales service to the customer?
Cost structure	What are company's fixed costs? What are company's variable costs? Which key resources and activities are the most expensive for the company`s cost structure? How the company can take advantage of economies of scale and scope?
Revenue stream	What are company's business revenue types? How company's customers will to pay? What is company's pricing strategy?

Table 6 *Business model Cavas questions*

3. METHODOLOGY

In the third chapter on this thesis present the methodology how the research is carry out. Purpose is to expand the understanding what kind of limitations effect to the study. This chapter also introduces how the data for empirical study is collect and analyzed.

3.1 Research method

The research design in this study based on qualitative single-case study methodology with semi-constructed interviews. According to Gephart, between literature and the methodological choices has to be fit (Gephart 2004: 456). On the other way, interviews give data to interpretations background and theory from literature support interviews. On this thesis, the strategy business model literature supports interpretations which coming from interviews. The main method in this thesis based on interviews and business model theories.

The research design on this study is abduction which is combination of induction and deduction. Eriksson and Kovalainen describe that induction builds reasoning conclusions from an observation to more general findings. Deduction is opposite for induction. Deduction builds reasoning conclusions from theory building and existing literature (Eriksson and Kovalainen 2008: 21). The starting point for the research in this study is deductive viewpoint. The business model theory based on previously theories and new business model will be a mix of previous models. Data from interviews will support the theory and expand the business model. This thesis will be a single-case studies and interviews support only this case. For that reason, the deeper theory-building process block out.

Interviews will be carried out to companies which main business area is bio based energy. Possible customer for the liquefaction plants are Stormossen, Biovakka and ST1 in Finland. Target is to get interviews from those companies' top management. In addition, my thesis content interviews from inhouse Wärtsilä. My aim is to get interview also from political entity which can give more information about how the Finnish government intends to support bio based gas because initially construction of LBG infrastructure needs political support. For instance, excise duty for all fossil based energy source. In this way, the interviews form three important areas which are government, supplier and possible buyers.

3.2 Case study

Case study is a one research method where try to describing a single event or unit of analysis (Gephart 2004: 458). According Yin (2003: 13) Case study is suitable research form to gather knowledge when studied phenomenon's contextual conditions are important. As business model developing the contextual conditions are important when company expand their business area. Business model need to fit company's overall strategy and the same time business model need to service customers the best way where the business model operates. For that reasons, the methodology based on case study method with semi structured interviews and market analysis.

Eisenhard (Eisenhardt: 548) states that when the knowledge about the phenomenon studied is less available, the case studies is exploratory study. In some cases, the case-analysis may act like a bridging stage between deductive and inductive research (Eisenhardt and Graebner 2007: 26). In case study methods, the data is collected close to the professional which allows to capture relevant knowledge (Gibbert, Ruigrok, Wicki 2009. 1465). Developing business model is general research topic, so there is lot of existing literature, theory and model about business model and developing business model. Problem is that, there is existing information about liquid biogas business, m what theory and model can use. For that reasons, the deep inductive single case study can be used to create better understand about liquid biogas business. Single case study is also compatible for research questions. The single-case study offers great opportunity to go close to the customer and get more information about customers' needs. In addition, single-case study

In single case study, the case study choice is the most important part in case study process. The significance of case study choice increase when using a single-case study. Case study method works when case is extreme or unique. In this way case give interesting and exciting results (Eisenhardt and Graebner 2007: 26; Johnson et al. 2007: 61; Siggelkow 2007: 20–21; Yin 2003: 38–39).

The next important question is why this case is important or interesting to justify a single-case study? The target company is global enterprise which operates in marine and energy business. LNG technology and number of LNG's end customers increase all the time in the market. Wärtsilä has a long history around the LNG business. They have

manufacturing LNG engine and single liquefaction plant but now they develop clear strategy for the LNG business and how they build their product portfolio and services for the LNG business. Creating business model for the product and service orientated technology company whose main market area is around the world, the case is unique and interesting. Currently company creates strategy for the LNG business and LBG business is one part of this. Business model has important role in this. In company has lot of tacit knowledge which needs to convert to service Wärtsilä's LBG business.

This study is a combination of induction and deduction. Deduction means testing theory. This means that theory is the first source of knowledge. Induction means building theory. In this case data is the first source of knowledge. Research proceeds from empirical research to theoretical results. Eriksson and Kovalainen (2008: 21) describe that deduction builds conclusion from theory building and existing literature. Induction is augmenting which draws conclusions from detail finding to general findings (Eriksson and Kovalainen 2008: 21).

The research design consists theory and interviews parts. Idea is that theory and interviews support each other and the result in the end will be finally business model for the Wärtsilä's LBG liquefaction plant strategy.

3.3 Data collection

The data for this thesis was collected by 12 official interviews. In addition, I have made several unofficial interviews in-house the company where I carry out the thesis. An official interview means that interviewee accepted the interview. Thesis contains two different type of interview. Part of the interviews carries out by phone and other part of interviews carries out by face to face. In face to face interviews I made also observation which give me information how the interviewee acting. The official interviews minimum length was 35 minutes and all interviewee have listed below on table 3.

The list of interviewees has made myself. The interviews have been shared two different categories which are core- and secondary interviews. For both categories, have made own semi-structured interview which give good possibility to go with the interview flow. Both semi-structures interviews are described in the appendix 3. Purpose of the interview structure was a general guideline for both categories. During those interviews my job was

to asking more detail questions. Every interview was confidential and interviews was conducted in Finnish.

Company	Area	Person	Position	Interview lenght (min)
Company A	Biogas producer	Person A	Managing director	75
Company B	Biogas producer	Person B	Development Manager	50
Company C	Biogas producer	Person C	Managing director	70
Company D	Biogas producer	Person D	Managing director	47
Company E	Biogas producer	Person E	Development engineer	65
Company F	Biogas producer	Person F	Managing director	65
Company G	Biogas producer	Person G	Chairman of the Board	35
Company H	Marine consultant company	Person H	Managing director	39
Company I	University	Person I	Professor	37
Company J	Logistics	Person J	Managing director	35
Company K	Cleantech	Person K	Vice President, Technology	45
Company L	Financial	Person L	Investment Director and Partner	35

Table 7 *Data collection interviews*

After the interviews, starting systematic analysis process.

3.4 Analysis method

According to Johnson, strategy development process need a good unit of analysis (Johnson et al. 2007: 58–60). Interviews' systematic analysis is good choice for analysis method. Before the analysis process, first step was transcribed all interviews word by word. Second step was identified and classify every interview. Third step was transferred the classifies data to separate documents and fourth step was analyzing those separate documents' data. Fifth step was understanding and compare interviews between each other and add observations. That is the key to using multiple source of evidence which will increase the validity of this study (Yin 2003: 34–36)

3.5. Methodological limitations

Interviews are good source for data collection but there is also some limitations because people knowledge level is higher than past which they can use to describe the past actions. This can be a problem when using lot of informations who understqand the business very well and they have diverse perspective about the business. Interviews are good choice for main method because interview is a efficient way to cathc information from the industry. Useing many as possible participants on interviews scope from different aspect, you can eliminate the bias (Eisenhardt and Graebner 2007: 28-30). Accordign to Johnson et al. (2007: 68) interviews are suitable way to collect knowledge about the business.

My knowledge of biogas business is also one limitations because I have a limited time to increase my knowledge in totally new business area. This can be also possibilities because I can thinking a new way and make a totally new proposal for the business.

The results of this study coming from single-case study method. This means that results are difficult to replicating to the different case on different enviroment. The single case study method cause the lac of external validity. Results coming by using analytic generalization and theoretical frameworks have formed from literature (Gibbert et al 2009: 1468; Johnson et al. 2007: 72; Yin 2003: 10, 35–36).

In qualitative studies the clear guidline lack which follows throught the study from begingni to the end concluson. Gephard presetn that good research queston and clear target of study should be the most important guidline for the reseracher. The purpose of the research question is to kept as clear as possible which influence to clear structure on the research (Gephart 2004: 456 - 460).

4 RESULTS

In this chapter introduce briefly the case study and current situation. This chapter also content feasibility study which describe the environment where doing LBG business, consumers and markets structure and competition analysis.

In this chapter, the collected data is presented and show what kinds of findings are made. Empirical findings divided into two different categories like the interviews are made. First category is core interviews which contain only biogas producers. Second category is secondary interviews which contain different stakeholders around the biogas business for example equipment suppliers, finance, research and consultant. In addition, are biogas producers and other stakeholders. Both categories interview's structure has been presented in appendix 1 and 2. Finally presented two business model options.

4.1 Business enviroment

Feasibility study purpose is to describe the current situation and increase the readers' knowledge about the biogas business environment. What different technologies are available? What different drivers control gas and biogas business in political, environmental and social way? The structure of feasibility study analysis is presented in figure 6. Study content three different parts which are environmental analysis, industry and market analysis and competitive analysis. Information for the analysis is collected from different written sources from consultant companies and interviews. Some of interviews was unofficial but data coming directly from the political sources.

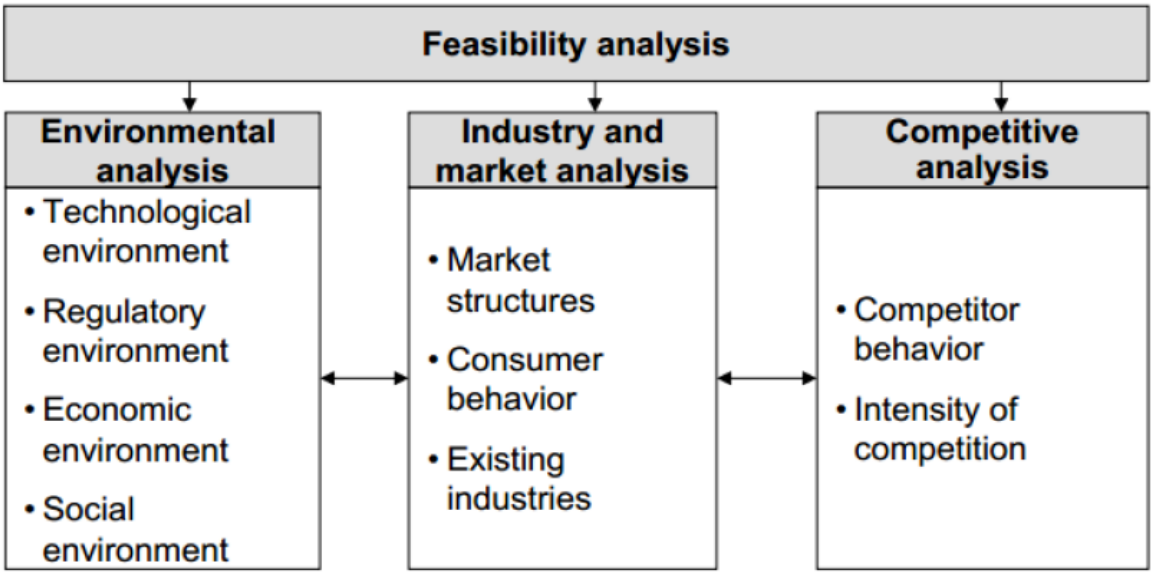

Figure 6 *The structure of feasibility study analysis (Wirtz 2011:199)*

The environmental analysis based on PESTEL analysis. It consists only four different elements which are technological, regulatory, economic and social environment. Extended PESTEL analysis consist two more elements which are political and ecological (Vuorinen 2014:220). In this case regulatory element will content political and legal perspectives.

Biogas business technological environment is very wide because the value chain content many different phases. In every phase are available many different technologies, see figure 7. In this study, focus area is only liquefaction plants. Assumption is that the biogas methane content will be over 95 percent. In the market are many different technologies which can use in liquefaction process. However, there are only two suitable options for the commercially purpose which capacity range is between 2000 TPA and 300 000 TPA. Those two technologies are Reverse Brayton (RB) and Single Mixed Refrigerant (SRM). Every competitor has developed own process which based on SRM or RM technology (Reinlund 2014:18-25).

Overall the biogas production is a local so the capacity is smaller than the natural gas liquefaction production. For that reason, the capacity range can be limited from 2000 TPA to 30 000 TPA which is suitable for liquid biogas production. Larger than 30 000 TPA production units, access to raw material for biogas production causes problems. One options is to replace the missing biogas with natural gas like figure 7 show.

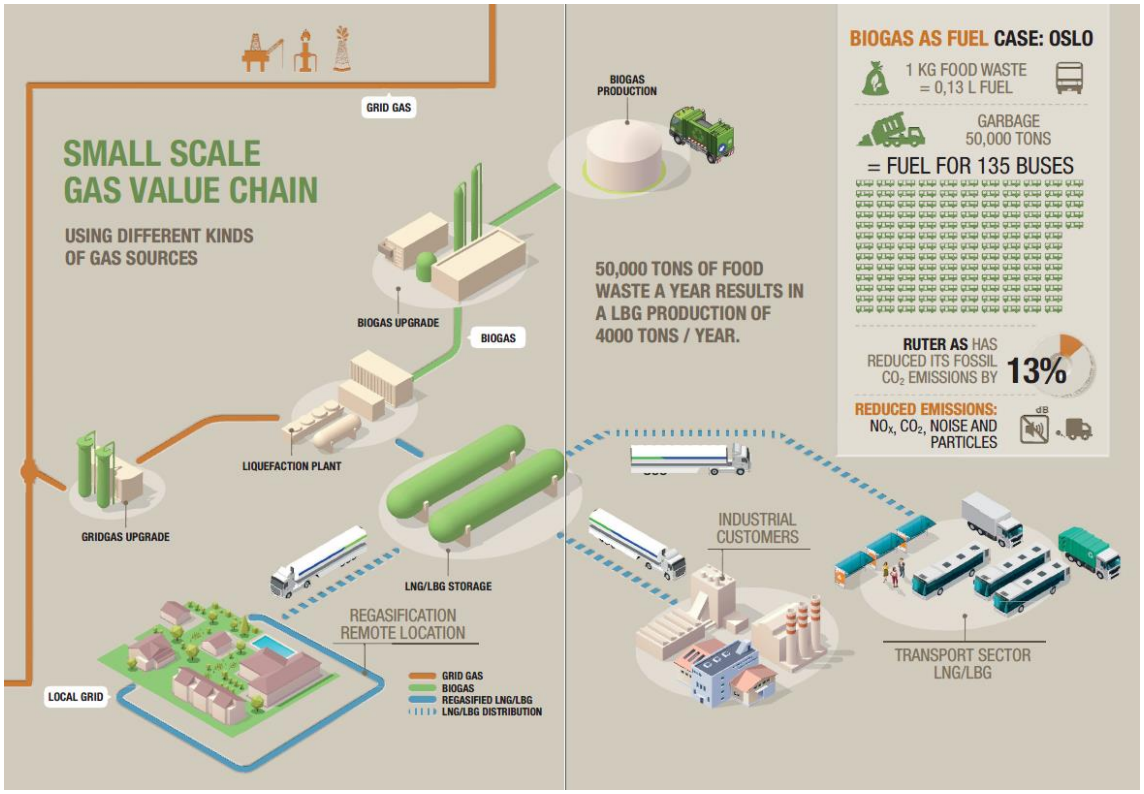

Figure 7 *Small and mini scale gas value chain system (Wärtsilä oil & gas systems 2014:2-3)*

Regulatory environment is much more complicated because the end customer is unknown currently. All political and legal decision in energy business will influence directly to gas energy business. Unknown end customer will influence directly to LBG production because liquefaction plant buyer doesn't know who his customer will be. Regulatory largest problem from biogas viewpoint is coherence and sustainability. Currently the government's support systems guide the biogas producers to produce heat and electricity because they offer support money for that (Åkerlund 2014:5-11) (Energy authority). In practice this means that biogas producer produces raw biogas only and government's support system will make their business to profitable. This will not a way how sustainability energy source beat fossil based energy sources. All problems will come out when government terminate the support system (Åkerlund 2014:12-15).

Biogas product industry will reach the profitable level without government's tariffi system if raw biogas methane content upgrading to over 95 percent and use vehicle fuel or make liquid form. Financial support system need to build up around the startup investment and tax system which support renewable energy sources. If the support system is unclear, it will slow the investments. System will not support companies who are early

operators in the market which also slow down the development of LBG industry. LBG business has also direct link to the LNG business. For that reasons, some of regulations in LNG business influence also to LBG business (Wärtsilä internal gas report 2014).

Economic environment will depend a lot of how end customer market will develop in the future. If LNG purpose in future will be only gas state to transportations, LBG future will be weak because LBG manufacturing costs are much higher than LNG. If LNG will be fuel options for vehicles and vessels, the local LBG production will jump up on the next level in profitable perspective. In this case biogas methane content increase to more than 95 percent and it makes possible to supply the same gas grid with the natural gas. It is also important to note that suitable applications for LBG/LNG are heavy vehicles, vessels and trains (Morgan Stanley 2013: 6) (Vuorela 2014) (Piellisch 2014).

Biogas or gas is better fuel options for passenger cars and commercial vehicles because the operation distance is much lower than heavy vehicles and ships. When the vehicles operational distance is less than 500 km per day, fuel can be in gas form. LBG is suitable fuel for the vessel with LNG. For instance, government could set up the minimum limits for using renewable fuel. In that case, biogas would be suitable options for the vessel with LNG. Economics is also attractive for long-distance trucks but liquid fuel is better option than gas. Number of gas car grows worldwide 15% p.a and at the end of 2012 number of natural gas car was 16,7 million vehicles. United State, China and Japan are the largest countries (Morgan Stanley 2013: 6) (Vuorela 2014) (Piellisch 2014).

Currently, around the world LNG supply and demand increase all the time. See figure 8 and 9. LNG infrastructure rise up all a around the world and for instance EU support the LNG terminal infrastructure building. EU's target is to build working LNG infrastructure around the Europe. Figure 10 show how rapidly global LNG supply and demand is developed and what is future direction. LNG supply expected grows 7.8% p.a. LNG infrastructure support also LBG business because LNG is the key driver for the gas business. The new building ships are mostly flex fuel options which can use LNG/LBG. Heavy truck markets develop all the time. In USA and China have many trucks which use LNG. In Europe has also few truck but those markets need to develop more. Same time LNG market will give huge opportunity to LBG markets.

Liquid natural gas (LNG) market has been developing rapidly in recent years and currently the world's gas reserves are larger than oil reserves. This means that the main energy source will change from oil to gas in future. See figure 8. Figure based on BP

energy outlook 2035 reports. Figure 1 show that share of fossil based primary sources of energy decrease steadily. Coal is exception which has been the most rapid growth of all fossil based energy source in the past 10 years. Chines economy has been the main driven for the coal (BP Energy Outlook 2035: 65). In the future the coal expected to become slowest growing fossil based energy source. It is also expected that in the next 20 years the trade flows of oil from the Middle East into Europe and America are starting to decrease (BP Energy Outlook 2035: 33). On the other hand the significant growth based on for gas and renewable energy sources (BP Energy Outlook 2035: 71).

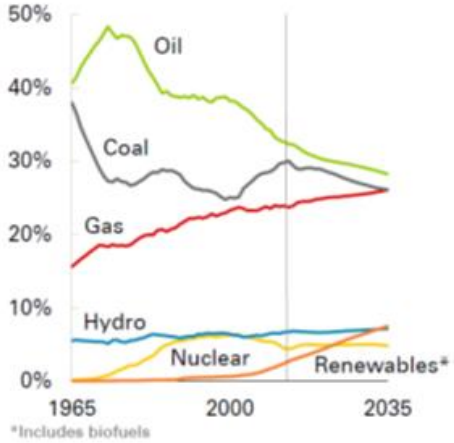

Figure 8 *Shares of primary energy (BP Energy Outlook 2035: 14)*

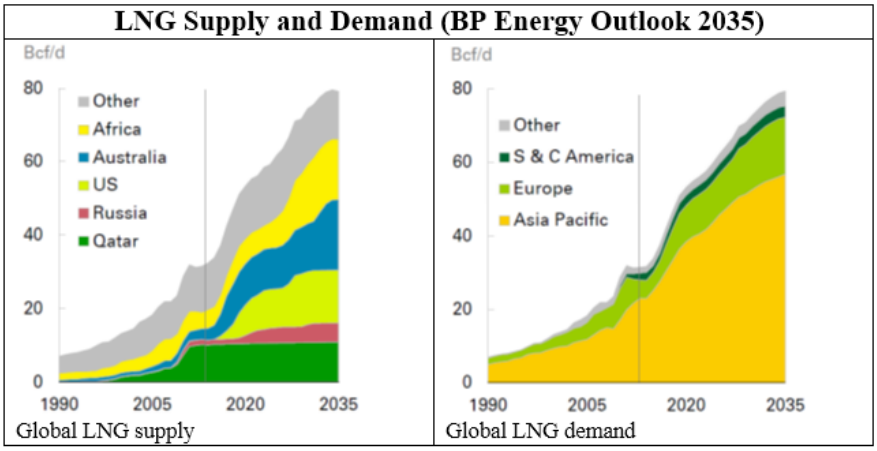

Figure 9 *Global LNG supply and demand (BP Energy Outlook 2035: 56)*

Based on European Biogas Association statistic and figure 10, In Europe has 282 biomethane plants and those plants' production capacity is 1,303 billion m^3 biomethane per year. Biomethane methane content in this statistic is 99 percent which is same methane content than natural gas. Statistic also show that Germany and Sweden is key

driver is biomethane production business. Average biomethane plant produce biomethane 3370 tons per annum and 530 m^3/h. Average biomethane plant need raw biogas 810 m^3/h.

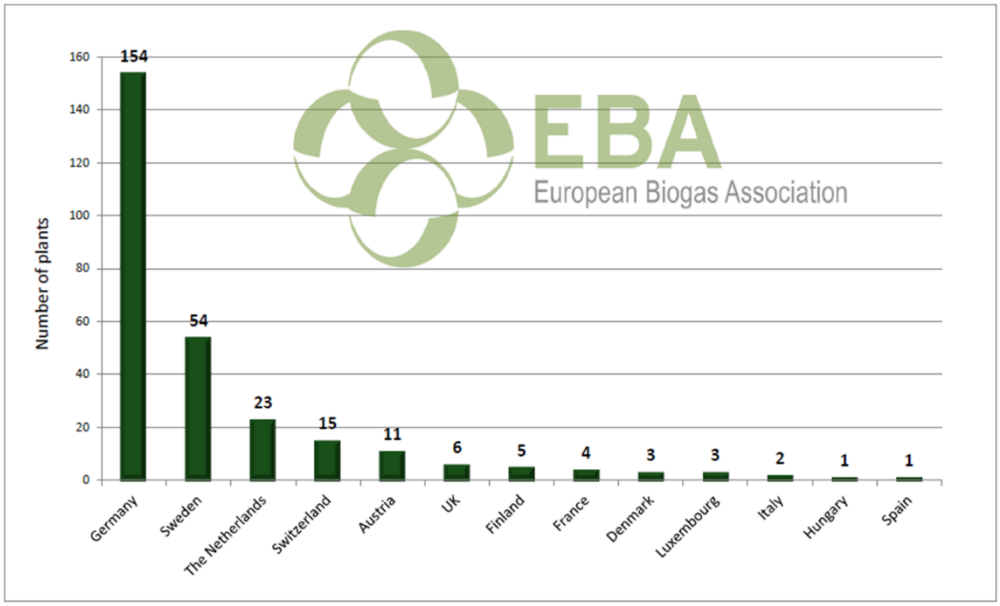

Figure 10 *Number of biogas plants in Europe (European Biogas Association report)*

Currently, the markets not define standard liquid biogas price because buyer and producer suit the price with each other. On the other hand, liquid biogas users are marginal in the market which influence the liquid biogas' price. The energy content is same in LNG and LBG. For that reasons, we can use LNG selling price for LBG selling price. LNG selling price varies around the world. Below is figure 11 which presented the LNG selling price in different places around the world in April 2015. In calculations are used Belgium LNG selling prices. Unit is USD/MMBtu.

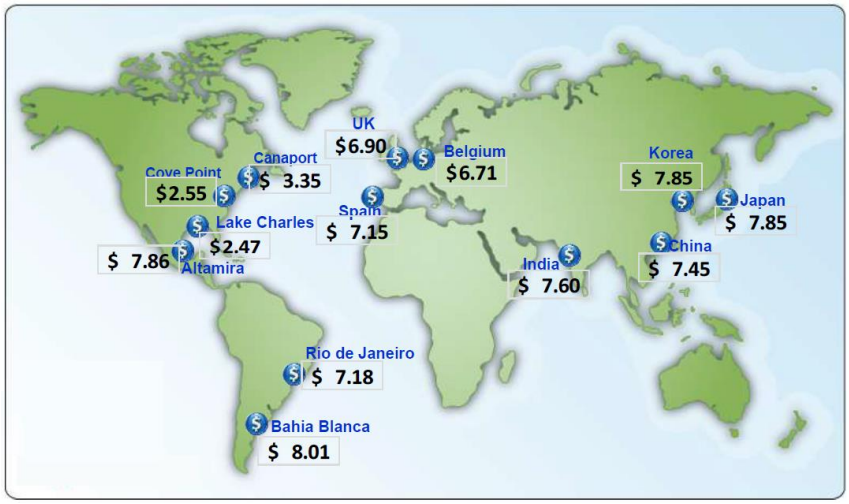

Figure 111 *LNG selling price around the world*

One ton LNG is 48,7 MMBtu. If LNG price is 6,71 USD/MMBtu, one ton LNG cost 327 USD. So Wärtsilä's 17 TPD LBG plant can generate money 2,028 million USD when LBG selling price is 6,71 USD/MMBtu.. Now is important to note that the LNG price is selling price which contain all parts for example production costs, distribution cost and taxes. LBG has good position in market because it is tax-free. LBG's distribution channel is also lighter than LNG's because LBG is local energy source. On the other hand, LBG can also exploit LNG's distribution infrastructure.

BP thinks that world going to see strong growth in the supply of gas and the main driver is US shale gas which continues to grow rapidly (BP Energy Outlook 2035: 53). The increasing supply of liquid natural gas opens up new gas sources to the markets. This means that the regions which are heavily dependent on imported gas, have had to trust on pipeline imports. In Future, the LNG open new gas resources for those regions. Liquid gas has major effects in terms of how gas prices are likely to be set across the world, with gas prices in different markets moving in greater unison.

In the next 20 years, the global natural gas demand grow and expected grow is 1.9% p.a. reaching around 490 Bcf/d by 2035. Power and industrial sectors will use 80% of total demand. Transport will be the fastest growing sector. Currently, the base is very small, but in future share of total natural gas consumption rising to 3% by 2035 (BP Energy Outlook 2035: 51). Figure 2 present how LNG supply and demand develop from 1990 to 2035.

The LNG market is ready for rapidly growth with large amount of new projects adding. LNG's supply expected to grows 7.8% p.a. (BP Energy Outlook 2035: 57).

Market structure is quite simply in Europe because EU is set couple target to fight the climate change. EU's target is to reduce greenhouse gases by 20 percent by 2020. Transportation fuels need to content accelerated rate to renewables energy in EU's area. These targets support potential biogas capacity which energy content is over two modern nuclear power plants capacity and Europe's infrastructure. Arable land is available also for non-food plants around the Europe. The role of high tech industry is importance for Europe in energy, chemistry and automotive industry. Europe infrastructure support to develop biogas enrichment technology. Natural gas network is a well-established in Europe (Global intelligence Alliance 2010:17).

The consumers behavior is very clear based on the interviews. Firstly, biogas producer need to find out investors. Most of biogas plant produce only raw biogas. For that reasons, consumer need to investment upgrading plant and liquefaction plant to get better price for product. Secondly consumer need turnkey delivery contract because they have not enough resource to manage all steps. Third behavior is after-sales service. For consumer is important that liquefaction plant is easy to operate which means that consumer does not need bind resources for operating plant.

Existing industries content several companies who can delivery liquefaction plant for biogas liquefaction production. Those companies are Indox Cryoenergy, GE Oil and Gas, Cyrostar, DGE-Wittenberg, Linde Engineering, Dresser-Rand, Cosmodyne, Cyronorm and TGE Gas Engineering. On the market can be also other smaller competitors. Cyrostar and Wärtsilä are companies which offer product for LBG production. Other companies can delivery LNG technology. LNG and LBG production is quite same. For that reason, those other competitors are take into account in this study.

Competitive analysis based on Porter's five forces analysis. Porter's five forces model is good strategic tool to understand the company's competition environment. It is important to understand the forces which shape the industry competition. It is good starting point to develop the strategy. Model take into account the suppliers, customers, substitutes, new entrains and competitors. The industry area affects the configuration of the five forces. In different industry, the focus is different issues. All industry is a common force which is profitability. Profitability determine the strongest competitive force. Same time

profitability is the most important in strategy formulation proses (Porter 2008) (Peng 2009:42).

Porter's model consists five factors which are bargaining power of buyers, bargaining power of suppliers, threat of new entrants, threat of substitute products or services and rivalry among existing competitors. Below is a figure 12 which show how those five factors linked each other.

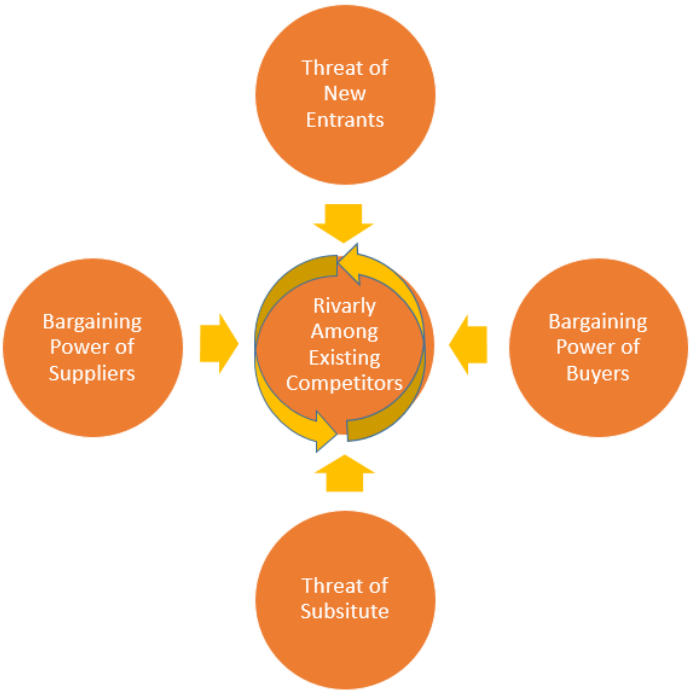

Figure 12 *Porter's five forces model*

Results of competitive analysis are as follow. Bargaining power of buyers is high because the end customer is unknown. For that reason, on the market are more liquefaction plant suppliers than buyers. Bargaining power of suppliers is low because the liquefaction plant's components are basic components. Switching costs are low and the number of purchased components are low so economics of scale does not decrease the prices significantly. Long term relationship between supplier and buyer can increase the supplier's bargaining power.

Threat of new entrants is difficult to estimate because the technology is not complex but the markets are not developed. Economics of scale will not bring competitive advantage for the company because the number of potential plants on the markets are low even if the company operate around the world. New entrants also need capital requirements for manufacturing facilities and executing delivery projects. Capital requirements can be a little problem because company need 1-2 million Euros to get finance for 5-10 million Euros delivery projects. For that reason, the industry is not attractive and threat of new entrants is medium. Threat of substitutes exists because companies try to develop liquefaction process. For buyer, the switching costs are high if buyer has already made the investment. For that reason, the threat of substitutes is low.

Intensity of rivalry are high because on the market are many liquefaction plant suppliers but not many buyers. Intensity of rivalry affect many issues. The main issues is how LNG develop in future. If LNG become main fuel for trucks, ships and trains, LBG future is brighter than now. LNG is the main driver which influence how LBG industry growth. That also increase the rivalry because markets become more attractive. Product difference and diversity of competitors are quite minor because currently only couple liquefaction technology is commercial. Diversity of companies can divide into two categories which are large world-wide companies and local operators. Large world-wide companies are for instance Wärtsilä and General Electric which are known world-wide. Local operators are for instance Cyrostar and Linde Engineering which operate currently only in Europe. Company's brand also affects the rivalry. If company operate world-wide, the credibility can be better than local companies. On the other hands, consumers appreciate very high domestic technologies and local companies have strong position in that competition. Consumers believe that cooperation with small local company can run better than global company.

4.2 Case study

The case study target is to develop new business model for Wärtsilä's biogas liquefaction plant business. Wärtsilä's role is to design, making and delivery the liquefaction plant for the customer. Business model's also need to build the direct link to Wärtsilä's overall LNG business model and strategy. In other words, the LBG business model should be Wärtsilä's LNG business model's sub model.

Current situation

Wärtsilä's main idea is to be only turnkey equipment supplier which deliver different size of liquefaction plants. There is a clear line between equipment supplier and gas producer/distributer. Small scale gas value chain content all liquefaction plants which production capacity is under 1 000 000 tons per annum (TPA). Above mentioned capacity is too large for LBG production because biogas is local energy source and over 1 000 000 tons per annum LBG capacity need large amount of raw biogas flow which is inefficient to organize. Small scale gas value chain can divide small and mini scale gas value chain. Mini scale gas value chain content all under 30 000 TPA liquefaction plants which is the right scale for biogas business. The case study viewpoint is manufacturing and delivering the liquefaction plant for mini scale LBG markets. It is important to understand that same technology is used also in LNG markets. If both markets put together, the markets growing and for producer open new possibilities to producing different gas mix.

Liquefaction plant economy is important to understand. Liquefaction plant's end product is liquid biogas. The end product capacity defines the economy of liquefaction plant. The ideal situation is that the liquefaction plant could produce liquid biogas all the time without any production interruption. Liquefaction plant requires maintenance work 1-3 days per year. Wärtsilä has three standard sizes which capacities are 10 TPD, 17 TPD and 25 TPD. In level of year this means that those three standard sizes can produce liquid biogas 3600 TPA, 6200 TPA and 9000 TPA. This means that standard sizes liquefaction plants' need raw biogas 870 m^3/h – 2165 m^3/h. In calculations has been used raw biogas methane content 65 percent. Wärsilä's standard sizes liquefaction plants and capacity numbers are presented in table 4.

Plant	TPD	TPA	raw gas m^3/h
1	10	3650	870
2	17	6205	1490
3	25	9125	2165

Table 8 *Biogas plant capacity*

4.3 Interviews

This thesis contains seven core interviews. Every biogas producer sees that biogas is future energy source. The biogas problem is that the clear direction is missing. The largest

difference between producers are the understanding who is end user for the biogas and what is the biogas main purpose in energy market.

The interviews show that biogas future direction is unclear and every producer have own vision what will be the biogas main purpose. Biogas main purpose can divide into two different categories which are a traffic fuel and energy source for the heat and electricity generation. Previously mentioned categories are only main categories. Both categories are also many subcategories. Traffic fuel can divide into six subcategories which are vehicle fuel, short distance heavy trucks and busses fuel, long distance heavy trucks and busses fuel, marine fuel, airplane fuel and train fuel. Heat and electricity generation can divide into two different categories which are industry and private house.

All biogas producers see that biogas will be the future traffic fuel.

In future biogas will be the traffic fuel options because EU support biobased fuel. Biogas has also other options. Many companies buy biogas and replace the oil (Person A, managing director, Company A).

Biogas has very bright future. In future traffic and industry will be the biogas' main users (Person B, Development Manager, Company B).

Biogas has great future in traffic fuel sector. CBG will be the alternative options for private vehicle and city busses. LBG will be the alternative options for the long-distance trucks and vessels. In marine sector has available engine technology for LBG but in truck sector the engine technology need develop more. For example, Volvo's engine does not provide enough power (Person C, Managing director, Company C).

Biogas has many different options. Traffic fuel could be one potential options but the competition between biodiesel, electricity and biogas is staff. Other options for the biogas are heat and combination heat and power CHP. What is the direction of biogas depending on how Finnish government support biogas production? LBG is also one options but LBG production need a large liquefaction plant and stability raw gas flow and also high investment support (Person D, Managing director, Company D).

In future CBG will be the traffic fuel and raw biogas for electricity production (Person E, Development engineer, Company E).

Heat and traffic fuel are the best direction for the biogas. Especially CBG and LBG are suitable for traffic and both have own customer segments. Electricity production is not profitable so the main focus is to develop the traffic fuel production (Person F, Managing director, Company F).

Biogas main purpose will be the traffic fuel. CBG is good options for the vehicles and LBG is good options for the heavy trucks but engine technology need to develop more (Person G, Managing director, Company G).

The above quotations show that biogas has many different possibilities. Raw biogas production is easy to start because investment costs are low. The amount of investment depends on how much producer want to produce biogas. If producer want to start LBG production they need to make large investment to the production facilities and plant. This means that only few producers have ability to invest LBG plant.

We have the ability to invest in LBG plant but we need more specific calculations about LBG economy. Currently we only wait what happening in the field of LBG (Person B, Development Manager, Company B)

We have a desire and ability to develop biogas to LBG form. Problem is to find out the end customer partner and finance partner. The first infrastructure investment cost is around 30 million euros. Today's problem is to find out the right partners who want to develop the LBG infrastructure together (Person C, Managing director, Company C)

We have the ability to invest to the LBG plant if the right finance partner finds out. Currently, the finance partner is hard to find but we develop the LBG possibilities all the time and we have planned where to the LBG plant placed (Person F, Managing director, Company F)

The interviews prove that invest to the LBG facilities is difficult for the companies. All producers are interested in LBG production but the producers can divide into three different categories. First one is developers which are the LBG driver and try to develop LBG business. Their target is to find end customer partner who start to use LBG and investment partner who is ready to invest LBG infrastructure buildings. Second group is followers which have ability to invest but they do not develop and try to find end customer partner. When developer show how LBG business running and end customer is existing, follower start to invest. Third group is waiters which waiting that Finnish government

give large investment support or they have no ability to invest and try to find possible end customer and finance partner.

Biogas producers have also criterions to the plant and liquefaction plant supplier because the investment is large and they need to manage possibly risks. The main issue is that liquefaction plant supplier need reference which show that plant works. Producers accept only turnkey delivery project which means that liquefaction plant supplier need to prove that they have ability to delivery working plant on the time. In addition, producers want also after sale service to the plant and possible finance partner

Interviews show that producers have several criterions for the plant which are listed above:

- Easy to operate
- Low operation cost which are knowing exact
- Operational reliability need to be in high level
- Low maintenance cost

Without above criterions, producers have no interest to invest to the liquefaction plant.

This thesis contains five official secondary interviews. The purpose of the secondary interviews group was to build comprehensive mix which contains people from every stakeholder. Thesis target was too ambitious because some of companies see that Wärtsilä was their competitor or biogas competing with their product. For that reason, they refused to give official interviews. In addition, political viewpoint to biogas business remained a dream because. Secondary interviews were also important because those interviews give new viewpoint to biogas business and lot of information which support the producers' claims.

University viewpoint was quite interesting which support the biogas producers. The professor sees that: There are lot of unused biogas potential but entity of bioenergy does not solve the energy problem. This is important to understand (Person I, Professor, Company I). Professor says that Biogas can solve the one small problem and the support system needs to build around that problem. Biogas in future traffic fuel will be the reasonable way to use biogas so in traffic sector has biogas lot of potential. Biogas and LBG have clear benefit in production because bioethanol and biodiesel production plants need large raw material volume. Biogas and LBG production need less raw material to be

profitable. This is clear competitive advantage for biogas and LBG (Person I, Professor, Company I).

Professor sees that biogas has several problems to become traffic fuel. Professor says that The places where gas is not traffic fuel, gas and LBG need to do more positive and easy to use for customer. Second problem is to find out the customers. Tax benefit is great incentive to direct customers to use biogas or LBG. Third issue is costs (Person I, Professor, Company I).

Professor sees also that distribution channel is problem which needs to solve before to biogas could be attractive options for the traffic fuel. Professor says that the area where the gas pipeline does not reach, the logistics to be arranged. Distribution channel need to be effective which contain gas pipeline and transmission network (Person I, Professor, Company I).

Professor says that Biogas strengths are simple process, investment costs are low for biogas process, growth potential is high in Finland and other countries around the world, business concepts are undeveloped which offers lot of different business options around the biogas business. Clear strength is also if biogas can be controlled directly to gas pipeline, distribution is easy to arrange (Person I, Professor, Company I). On the other hand, Professor see many weaknesses for the biogas. Biogas has many weakness and threats. Currently, supply and demand is problem. Gas pipeline network does not cover the entire Finland which limits the amount of customer. Biogas needs also more positive cases. Currently, the investment courage is also at a low level and sudden changes in support policy effect for that. Finnish government support policy is too short term.

In marine sector LNG and LBG will be the future marine fuel option. Managing director says that LNG can become overbearing marine fuel in the long term. Currently the LNG is dominant in certain regions. LNG future will be the coastal maritime transport, river traffic and emission control areas. It is important to note that battery technology also develop all the time and small ferries can operate by using batteries when the distance between point A and B is short. (Person H, Managing director, Company H).

LNG has couple problem in marine sector which prevent the LNG for the marine fuel. Managing director says that:” LNG position in marine fuel sector depend on distribution channel and how it develops in Future. Second issue is tank technology. How effectively the LNG can be stored. Currently, C-type tank is the best way to store LNG on the vessel

but ability to bunkering for four or five weeks' endurance is not solved. New tank technology could provide LNG for long-distance route where the fuel capacity need to be four or five weeks." (Person H, Managing director, Company H).

Managing director has also a different perspective Always people talk about how clear alternative the LNG is and how low the emission of LNG is. Now is good to question LNG total emissions which contain all steps from production to end user. Some researches indicate that cleat diesel's total carbon footprint is lower than LNG. Of course, it is difficult to prove which one total carbon footprint is lower. Message is that, LNG is not clearly clean as people always think (Person H, Managing director, Company H).

The strengths of LNG will come from technology side. Director says that LNG or LBG clear strengths are better maintenance on the ship, very simply systems arrangement and safety. LNG is cleaner that oil which influence also how clean the engines parts and systems are. When the system is simpler and cleaner, it is easier to maintenance (Person H, Managing director, Company H).

Managing directors has clear understood what the weaknesses of LNG are. Director says that clear weakness of LNG is cheap oil price which getting cheaper all the time more. The price cap between LNG and oil influence how quickly the LNG infrastructure will rise up. This also influences the LBG demand in marine sector. Other weaknesses are low level of LNG standardization in commercial side which also affect to LBG. Overall Rules and regulatory rules should be harmonized globally. Today, every solution in marine sector is customized. The LNG bunkering plan customized for every ship. The last weakness is technology. Today, every engine supplier promises that engine can use LNG but previously in real life the ship owners have criticized that engines have methane burn problem. This means that all methane not burn inside the engine (Person H, Managing director, Company H).

Managing director has clear understanding what issues affect that the LNG or LBG could be credible marine fuel options for the ship owners. First and primary issue is fuel economy after that coming that coming technology innovations. All ship owners are interesting in about fuel economy and fuel consumptions. If you can prove for the ship owners that LNG or LBG is better options that oil based fuel, owners will choose the LNG/LBG. Secondary issues are green image and regulations. Currently, regulations are secondary issues because there are only Tier 1-3 rules which influence the emissions and the control area is quite limited and there are other solutions for the engine how to reduce

oil based emissions. Green image is other issues which coming from the ship owner side. It depends on the where ship owner operates, the green image can be a positive effect to owner's economy. On the market, there are many available solutions to increase the ship owner's green image. For instance, the battery technology popularity rises all the time (Person H, Managing director, Company H).

From the land side

The Vice precident has clear picture about the biogas future in Finland. In finland has many biogas plants but lage volume missing. That is the largest problem in finnish biogas industry. Economies of scale has a major impact on productivity. Economies fo scale provides better benefits to exploit the organic fractions. Same time collecting cost decrease which makes biogas production more attractive. In summary, biogas production will be the more attravtive energy form when the economies of scale will be better utilized (Person K, Vice President, Technology, Company K).

Biogas not solve the whole energy question in Finland. Everyone need to understand that biogas or biobased energy can not be the ground energy source. Biogas is excelent support energy source which can solve one local problem and provide support energy production for locally level. (Person K, Vice President, Technology, Company K).

LBG could be great idea but LBG has many problems for liquefaction process. Currently, benefit ratio of liquefaction process is weak. Same time the ecomonic position is weak also and I do not see that the government support biogas to liquefy. LBG has couple strenght which are compressibility and movable product. LBG has also many weakness which are high costs, too locally and suitable solutions in individual situations if somebody give support (Person K, Vice President, Technology, Company K).

Transport companies are potential end customers for the LBG. Environmental friendly issues increase all the time and companies will replace oil based fuel. Shipping companies could mix LNG and LBG with battery technology. Same thing could work for transportations companies in land base. LBG fuel for trucks is new issue for me. This is totally new issue but it is interesting idea but I do not see that it could be potential options for truck in near future in Finland because LBG distribution is not existing. For us the most important issue is to maximize the driven time. This means that the distance between A and B need to be minimum so the best options is to drive the route without stops or refuels. If you need refuels the truck, gas station need to be along the route. Currently, I

do not know any gas station which providing LBG (Person J, Managing director, Company J)

From investment side the biogas business looks little bit different. For investors, the attractive is the key issue. How attractive the business and sectors are what is the phase of business? Some investors invest only start-up companies in early phase and after that sell away. Some investors invest in developing phase when the start-up phase is behind and need to take the next step. LBG could be a potential traffic fuel but there is too many problems on the table (Person L, Investment director, Company L).

In my opinion that currently the liquefaction process efficiensy is quite bad. For that reasons the biogas liquefaction process is unprofitable whitout any support system. I see that, LBG production is more greenwash than market-based business currently.

4.4 Business model options

In this chapter presented two different business model options. Business models based on Osterwalde's and Pigneur's business model canvas and more accurate theory has presented previously in theory part.

In this case are available two business model which are licensing model and in-house model. Both two models are explained in detail in this chapter. Both options are presented also in figures 13 and 14. Larger figures are presented in Appendix 1 and 2.

4.4.1 Business model 1

First option is licensing. The main idea is that Wärtsilä sell only liquefaction plant technology to company B and company B carries out selling, making and delivering the liquefaction plants. This means that Wärtsilä has only technology responsibility and they need to focus only designing and sell to licenses. Licenses selling means that Wärtsilä sell only technology drawnings and rights to use Wärtsilä's design.

In this model Wärtsilä's key partners are the companies which sell Wärtsilä's licenses. Second possible key partners segment can be company which renting labor. Key activities in this model are only license sales and liquefaction designing. Designing also contain research and development activities. Key resources in this model are human and

intellectual. Human resource contains the employee in designing and sales. Intellectual resource contains Wärtsilä's brand, patent and developed technology.

The business model content four main value proposition which connects consumers and Wärtsilä's together. Those are listed below:

1. Technology which is attractive investment target
2. Less assembly work on the site
3. Minimized logistic costs
4. Reduces the risks

Fist value proposition is important from the sales perspective because consumers needs good sales argument. Wärtsilä's liquefactions plants features are low power consumption, standard capacities which are 10, 17 and 25 tons/day, short delivery time, Easy and quick start up and shut down of all systems, simple energy supply and designed for unmanned operation. Low power consumption is good features because it saves plant's users money. Standard capacity gives good references for the plant's users to estimate how large plants they need. Standard capacity allows the modularization process. Short delivery time provide earlier start for the production. This provides better cash flow for the consumer. Quick and easy start up and shut down time of all systems provide flexible production. This means that production is easy to fit for demand. Simple energy supply and unmanned operation is easy options for consumer. Biogas producer does not need more resource to operate liquefaction plant and plant take own energy from the process. In this way producer is independent and does not need external energy source.

Second value proposition is less assembly work on the site. This value reduces the customer's costs in site which increase the customer's profit margin. Second value proposition is attractive because site work is quite large piece from total costs. Third value proposition is minimized logistic costs. Technology is very simple and compact which is easy shipment in containers. Product transports does not need larger facilities which reduce the logistic costs. Product is easy to transport by using ship, train or truck. Last value proposition is reduced risk. The technology responsibility carries out Wärtsilä which reduce the customer's risks.

In this model, the customer segment is clear. The potential customer is company which want to start business in bio business or company which want to expand own product portfolio in bio business. License is perfect options for the company who want to start

product sales. Company need only focus on sales, making and delivery process. In this way, they can develop own knowledge. License is also excellent options for the company who want to expand own product portfolio. For Instance, Company who already produce biogas digestion reactors, they can expand company's product portfolio which support their business. Such as license partner is best options for the Wärtsilä because they have already well knowledge about biogas markets and customer network. From License Company viewpoint license is good options also. They can focus on their core business.

Customer relationship is organized by using Wärtsilä's sales persons. Their main duty is acquisition new customer and the focus customer segments are companies who produce biogas reactors and upgrading plants. The relationship for that segment based on human interaction. First contact takes Wärtsilä's sales person. When the deal is done and external company start to sell Wärtsilä's license, dedicated personal assistance is liquefaction plant designers. Customer retention responsibility is for designers and sales person. The main duty is for designers. Cooperation with license seller is important because designers get more information about how the liquefaction plant works and how deeply understand about bio markets. For customers, this means that they understand how important customer they are for Wärtsilä and Wärtsilä care about customer.

The main channels to raising customer's awareness is our own sales person who represent Wärtsilä on expos, conferences and take directly contact to the customer. Sales persons has huge role in this business model. Without good marketing person, company cannot get any licensing contract. Secondly, low level organization contain only one or maximize two sales persons. This means that, sales person need to understand the technology and commercial business very well.

Cost structure is very simply in this model. Wärtsilä's costs are only human and R&D costs. Human costs content salespersons and designer's salaries. Traveling can also increase costs little. Research and development costs content all costs what R&D needs. This part also contents some designer's costs and possible patents cost.

Revenue stream in this option is very simply because license fees are the only source of incomes. Some revenue stream also coming from service of support engineering.

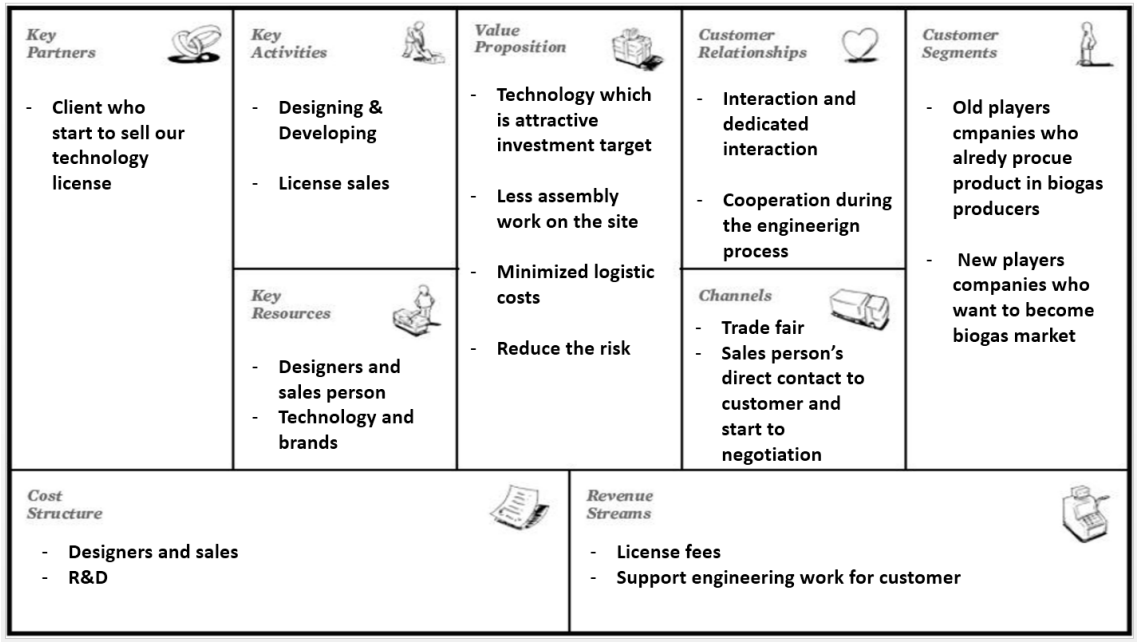

Figure 13 *Business model 1; Licensing model*

Overall this business model is good options because the costs are low but revenue stream is stable. Wärtsilä get license feed from technology but Wärtsilä does not need to tie up lot of resource and business still running forward. Wärtsilä has only technology responsibility and operational activates carry out external company. External company also carries out after-sales services which increase the external partners' business. License is good options if the biogas business is too small for Wärtsilä.

4.4.2 Business model 2

Second good option is in house model which means that Wärtsilä keep all ropes themselves and manage whole process. This option is more different than first one. The main idea in this model is that Wärtsilä manager all activities but using partners and out sourcing. In this business model, the whole project revenue stream coming to Wärtsilä. Wärtsilä carry out all risks and time responsibility.

In this model Wärtsilä need key partners because Wärtsilä cannot do all activities itself. Key partners in this model are sales agent, component supplier, site work and assembly, engineering subcontracting and after sales service. Local sales agent is important first contact because local sales agent knowing the market and local business culture. From

the customer viewpoint, local sales agent is easy to contact because they have same language and no cultural differences. Component suppliers are key partners because they are bottom neck in this business model. Supplier network need to work just in time if Wärtsilä want to delivery liquefaction plant on the time to customer. On the site Wärtsilä need to use subcontractors. After sales service is important issue for the customer. Based on interviews, contract need to content after sales service need. Customer want to maximize the carefree and does not to focus on liquefaction plant maintain.

Key Activities in this model are sales, design and engineering, research and development, project management, Sales activity is probably the most important activities on this model because without sales, Wärtsilä has not any liquefaction plant contracts. Sales is important activity but still Wärtsilä use sales agent on this model. This means that cooperation between designers and sales agent need to be in high level. The most important activities in house Wärtsilä is design and engineering which start to do cooperation with customer in early stage. The mean of sales is important to understand because sales activity in this model focus on first contact. Local sales man is best first contact who introduce Wärtsilä product and organization for the customer. Project management activity playing key role during the whole process. For the customer is important that product is delivered within the agreed time.

The main resource in this model is human resources. All main activities what Wärtsilä make himself, need human resources. Manufacturing resources Wärtsilä does not need because all manufacturing and assembly steps are outsourcing for key partners. Other key resources are Wärtsilä's brand, patents and technology. Wärtsilä brand is important because it helps Wärtsilä to get orders in. Technology is the resource which connect customer and Wärtsilä together. Technology is that resource which delivery Wärtsilä's value propositions to customer. Patents are more visible resource because technologies based on patents.

Business model option 2 content four main value proposition which connects customers and Wärtsilä's together. Those are listed below:

1. Decrease energy and operational costs
2. Quick start of production
3. Maximize production output
4. Minimize maintenance costs
5. Decrease the total risk

First value proposition is decrease energy and operational costs. Wärtsilä has developed and adapted MR process which is more energy efficiently. MR process makes possible to easy and quick start up time of all system. Shut down include also. MR process is also automated which makes possible to unmanned operation. Lower energy and operational cost increase the customer profit margin. Second value proposition is quick start of production. Wärtsilä's liquefaction plant design based on plug and play philosophy. Liquefaction plant's modularity is in high level which makes possible to short delivery time. Quick start of production provides early cash flow for customer.

Third value proposition is maximized production output which provide best production output capacity for customer. In this way customer can increase his profit because the amount of waste is minimized. Fourth value proposition is minimizing maintenance costs. Wärtsilä's MR liquefaction technology is simply and process' all components are conventional. For that reason, liquefaction plant is easy to maintain and decrease the maintenance costs. Last value proposition is decrease the total risks. Total risks in this model means that customer buy liquefaction plant by turnkey project and all risks carry out contractor. Customer need to only pay

The main customer segments are large biogas producers because they have ability to produce enough raw biogas. For instance, 17 TPD LBG capacity need 1500 m^3 raw biogas per hour. Other possible customer segment can be biogas buyer and mixer. Mixers mean that they produce liquid gas by using mixture of biogas and natural gas. Biogas buyers means that company invest only liquefaction plant and they buy raw biogas from other producer. This is new concept but also possible options because investment cost for liquefaction plant are quite same than biogas production plant and biogas upgrading plant.

Relationship between company and customer need to be personal interaction because every liquefaction plant is unique. Even liquefaction plants are standardized, it need every time to custom for customer needs. Customer relationship is organized by using Wärtsilä's organization. In sales phase Wärtsilä's sales persons contact to customer and start to negotiation. When negotiations going more deeply and contract is complete, Wärtsilä's designers start to design the plant together with customer. Personal interaction during the process is important because liquefaction plant is huge investment and its must to satisfy customer needs.

Channels in this model content several different phases. In first phase Wärtsilä's target is to raise awareness which is salesmen's' responsibility. They contact to potential customer and awareness our product options. Salesmen also involved in the different conference where they can meet customer and create better network. In second phase the negotiation connection exists and salesman and customer together define the liquefaction size and output criterions. In third phase the designers join to negotiation and customize the plant for the customer requirements. In last phase, the plant delivery to the customer.

Cost structure can divide in several parts which are component purchase and assembly, engineering and design, research and development and site work. Engineering and sales costs are not most expensive but the most important because liquefaction plant need to customize for the customer needs. This happened in sales and engineering phase and the value added also in those phases. Component purchase and assembly phase cost lot because Wärtsilä's need to purchase liquefaction plant's components and other equipment. Assembly and site work phase are secondly expensive phase. In those phases value delivery to the customers.

Revenue stream is quite simply in this business model. Wärtsilä and customer make EPC deal which means that Wärtsilä delivery the turnkey project. Customer pay part of contract price during the project but major part of contract price customer pay when liquefaction plant has been delivered.

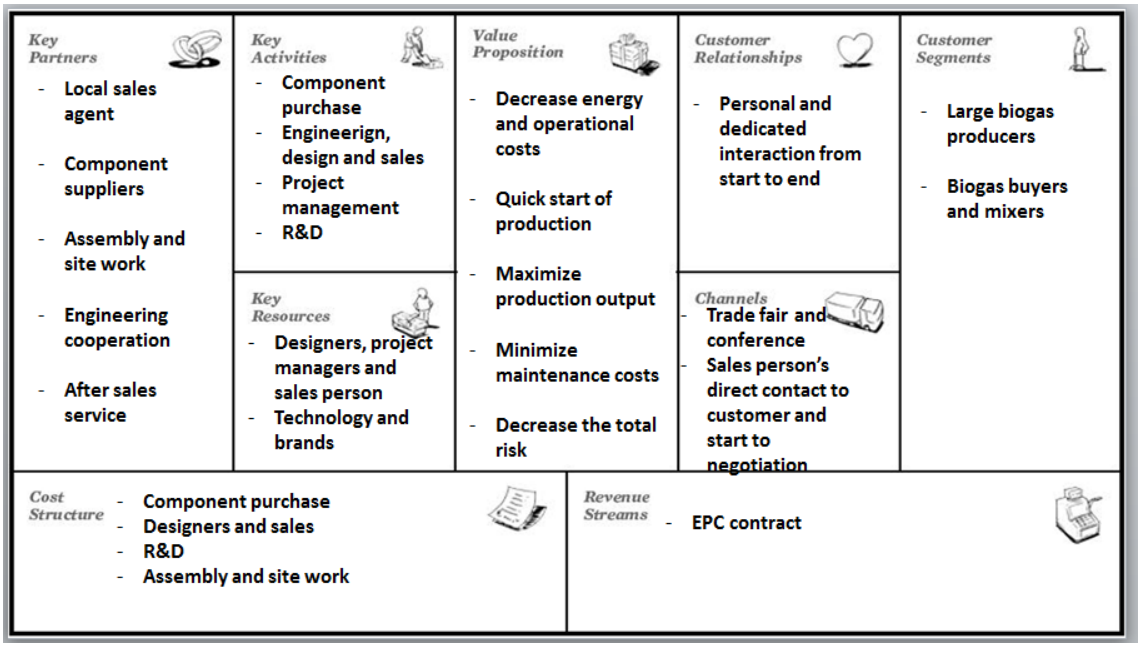

Figure 14 *Business model options two; In house model*

Overall the business model is good option and much more different than first one. This business model needs more resources and it is heavier for the Wärtsilä's organization. This business model makes possible to develop turnkey project delivery services. Project management will be in key role.

Third possible options is that Wärtsilä delivery only the liquefaction plant which include the design, components purchasing, plant assembly and plant delivery. On the other word, Wärtsilä deliver the whole liquefaction plant to the contractor. This means that one contractor sells the liquefaction plant to customer, makes site work, carry out guarantee work and maintenance work. Problem in this business model is that who contractor wants to do that kind of small business? Possible contractor could be for example YIT or Skanska but they have not customer for liquefaction plant business. Second reason is that the business without liquefaction plant delivery is too small.

4.5 Summary

There are two different business model options. Both options are good and choice depending how Wärtsilä see they possibilities. First model is Licensing model. The core idea is to find partner which start to sell, build and maintain the liquefaction plants. Wärtsilä only take licensing fee per plants. This business model is very easy to operate from Wärtsilä viewpoint. They only need employee who take care about the legal, licensing and technical issues. Wärtsilä's also need to give technical support to the licensing company and designing resources.

Second model is in house model. This model is much more complicated and heavier for organization than previous one. Wärtsilä's need to build up the organization which start to sell, design and build the liquefaction plant around the Europe. They need to build up the network for the engineering, manufacturing and servicing. Most of previous mentioned part are already existing but Wärtsilä need to collect those part together. Cost structure is heavier than licensing model but the value stream is higher. This makes possible to get higher profit than licensing model.

5 CONCLUSION

In this chapter, the collected data is presented and show what kinds of findings are made. Empirical findings divided into two different categories like the interviews are made. First category is core interviews which contain only biogas producers. Second category is secondary interviews which contain different stakeholders around the biogas business for example equipment suppliers, finance, research and consultant. In addition, are biogas producers and other stakeholders. Both categories interview's structure has been presented in appendix 3.

5.1 Theoretical implications

Thesis results prove that value proposition is the key element in the business model on the theoretical way. Business model purpose is to generate money to the company and owner and solve customer problem. According to Eyring (2014:91-93), value proposition has to solve customer problem in simply or effectively way. Same message coming from the liquefaction plant operators. If company wants to compete on differentiation, they will need clear value proposition what key process delivering with key resources. Competing on the price will be one issue because larger company's costs are typically much more higher than smaller company's costs.

The business model show that value is the key which can contain many different elements. Liquefaction plant operator is ready for pay if plant supplier is well known, customization, minimize the production failure, easy to operate with minimum cost. According to Tuulaniemi (2011), customer value contains various elements which are brand, features, customization, risk reduction and easy to use. Previously mentioned value elements are easy to attach biogas producers' needs.

Activities are part of value creation process. According to Kaplan (2009:21), business model must to describe the all key activities in value delivering process. On the both business model options design and sales are the important part of activities. In addition, components purchase and technical handling paly important role during the value delivery process. In these business models activities are part of important process. DaSilva and Trkman (2013) think, that process is one way to explain key activities. One

important process is purchasing process. Design and technical handling activities are included on the purchasing process.

Results of thesis present that Itami and Nishino (2010) idea from the business model is right. Both business model options must to contain profit model and business model. Profit model in both business models have included to revenue and cost structure block. License fee will be stabile turnover. Turn key solutions will come larger turnover and possible to earn higher profit.

The results prove that relationship management is important in both model. The base of customer is not wide. For that reason, customer expect more specific service from the service and product provider. According to Parviainen (2008:144), company's must to make research to understand customer expectations.

My research indicates that workable business model must to contain four elements. Those are key resource, key process, profit formula and customer value proposition. On the both business model basic idea is a same. Value proposition is clear what the key process will delivery with key resources. Profit model will take care that business will be profitable.

5.2 Managerial implications

The main purpose of this thesis is to develop the new business model for the Wärtsilä's bio liquefaction plant business which support Wärtsilä's overall LNG business. Second target is increase the understanding level about biogas business in Europe and particularly in Finland. This thesis end result will be the business model proposal for Wärtsilä's LBG liquefaction plant business.

Wärtsilä got two different business model options. Which one business model is better depending on the strategy choice. Licensing model is good option if Wärtsilä's purpose is to only offer the product with low own organization. The price can be also more competitive than Wärtsilä's EPC contract price because small company is more flexible and overhead costs are lower. In house business model is good choice if Wärtsilä's purpose is to sell large LNG infrastructure solutions for the customer and liquefaction plant would be one part of whole infrastructure. Wärtsilä can also sell liquefaction plants singly but then Wärtsilä's need to take care about the fixed and overhead costs. Otherwise

the small company price will be more competitive which give advantage for small company. EPC project strength is value stream which all coming to Wärtsilä.

In the end, both business models are good alternatives. The right choice depending on th Wärtsilä's strtategy decsisions to LNG business. If Wärtsilä's product catalog contain LNG small scale liquefaction plants, in house model is excellent choice. LBG liquefaction plant technology is same as LNG liquefaction plant technology. In this case, the organization has already created and LBG production offer market expand possibilities. If small scale liquefaction plants are out of the Wärtsilä's overall LNG strategy, licensing is the right alternative.

Wärtsilä got lot of information's from the biogas producers. Same time interviews and thesis was excellent marketing tools to expand their knowledge about Wärtsilä's gas products. Quite many biogas producers not know that Wärtsilä offer solutions to the biogas and liquefaction process. This study was road opener to many potential customers. Wärtsilä got many biogas producer's contact information to continue discussion to upgrading biogas production to liquefaction plant.

Biogas business in Finland is quite large. Here is lot of biogas producers and technology developers. Finland is the one of the top biogas producers in Europe. Research establishes that currently the markets are not ready for the liquid biogas. Low oil price slow down the investment for the LNG infrastructure which also affect LBG investment. The larger problem in liquid biogas business is that end customers who use liquid biogas are unknown. The available LBG technology for end customers is also insufficient. In marine sector the LNG technology is on a good level. LBG can use same technology like LNG. In truck sector the available motor technology is inadequate.

Interviews of biogas producers gave a lot of information about the business and their interest for liquid biogas business. Every biogas producer has optimistic picture about what is biogas position in future. Some of producers see that biogas position will be to replace the oil in industry and produce heat and electricity. Some of producers see that biogas will be the fuel options for the vehicles. Liquid biogas production also split the producers' two different categories. The part of producers does not see that the LBG could be the future fuel solutions where to invest. One reason for that is missing customer because the LBG has not clear market currently and the investment costs are high. Second reason is the corporate strategy. Some of biogas producers' strategy is to produce only

biogas for local consumer. This contain only gas for car, heating and electricity production. This kind of information will be valuable to the Wärtsilä.

Based on the interviews and studies, Wärtsilä got many partnership alternatives between producers and distributors. Message from markets was quite clear. Domestic markets need strong driver who can give financial support to LBG ecosystem. Wärtsilä is enough large company to take financial support responsibility to increase their market share on the small-scale gas business. One potential partnership is between Wärtsilä and Gasum.

5.3 Suggestion for future research

Next step in the research is to develop and implementation phase. Development phase will contain business model selection and develop the model on the next phase. On both models are matters which need specific clarifications. In development phase, purpose is to finalize the selected business model and fit it to Wärtsilä's overall LNG business model. How to fit selected business model to Wärtsilä's LNG business model could be one suggestion for future research.

5.4 Limitations

This study focusing only biogas business in Europe and especially in Finland. Wärtsilä's overall small-scale LNG business strategy not take into account in business model development phase. Specific analysis between overall business model and liquefaction plant business model missing totally.

Business model development phase based on Osterwalder and Pigneur canvas model. Other author's theories are taken into account but foundation of business model based on canvas' nine elements. This will be one important limitations.

PESTEL analysis based on only in Finland region and all biogas producers coming from Finland. Political environment based on Finland. European trends have tried to take into account but key driver is Finland's environment.

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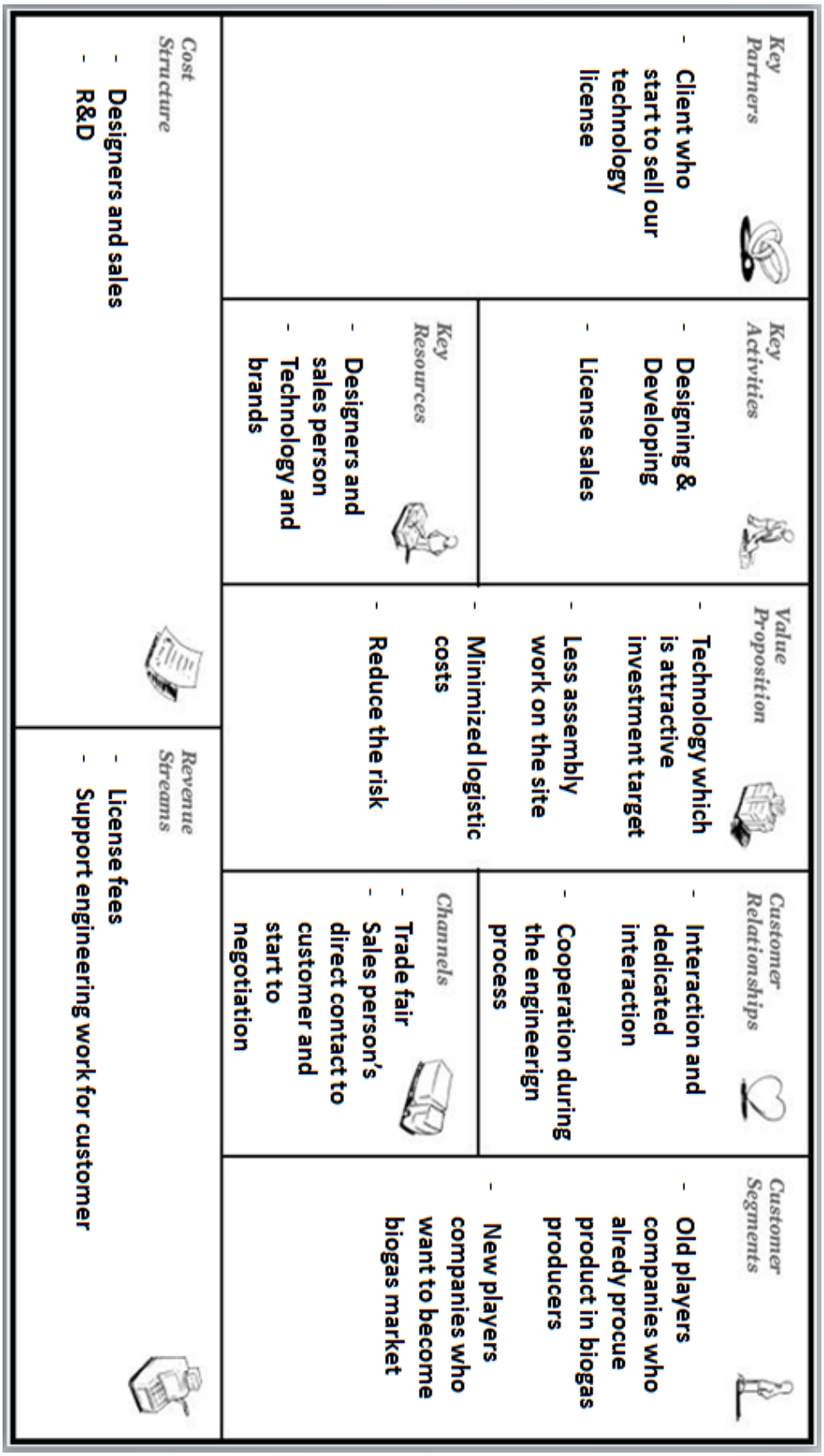
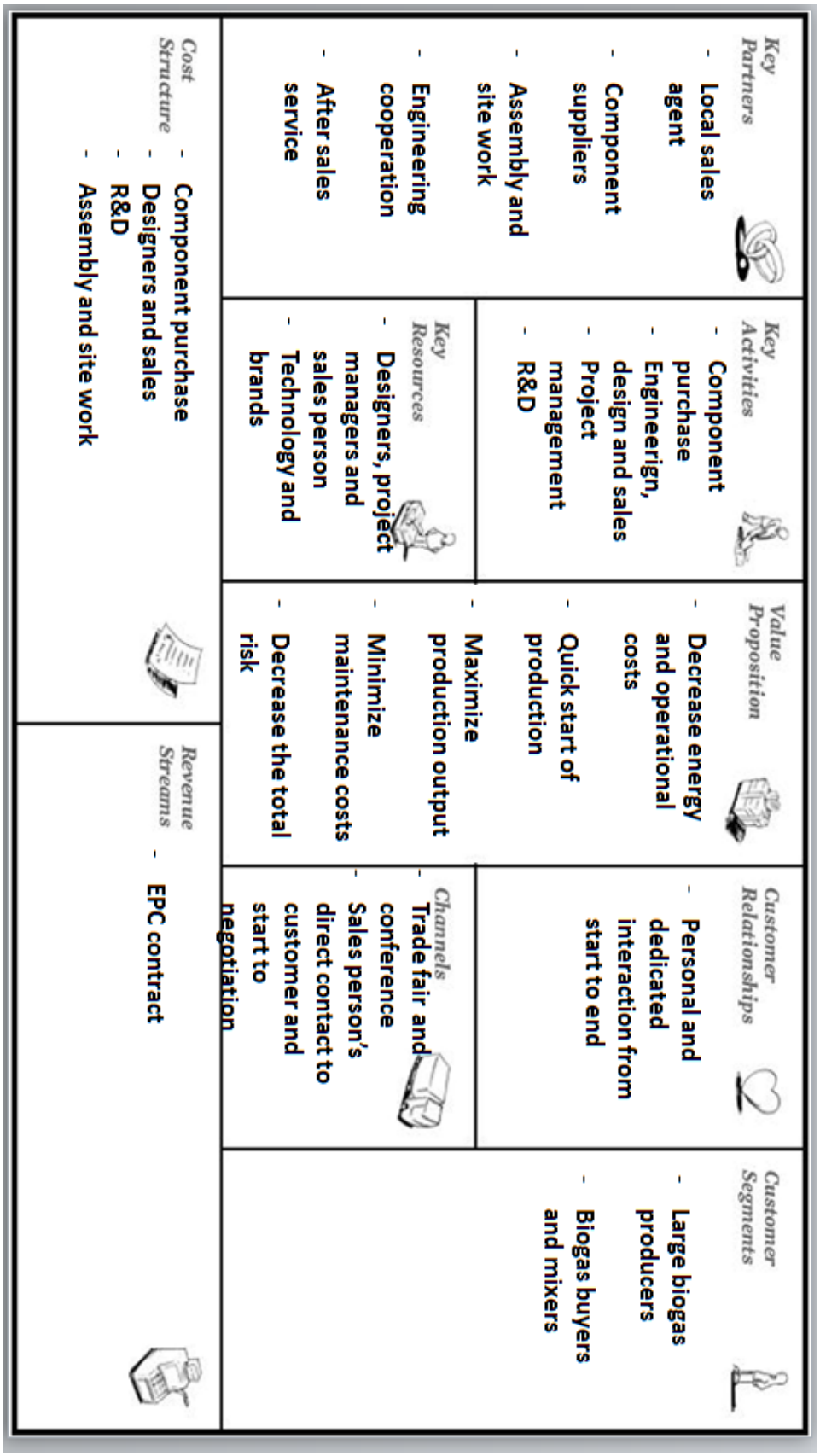
APPENDIX 1


Key Partners
- Client who start to sell our technology license
Key Activities
- Designing & Developing
- License sales
Key Resources
- Designers and sales person
- Technology and brands
Value Proposition
- Technology which is attractive investment target
- Less assembly work on the site
- Minimized logistic costs
- Reduce the risk
Customer Relationships
- Interaction and dedicated interaction
- Cooperation during the engineerign process
Channels
- Trade fair
- Sales person's direct contact to customer and start to negotiation
Customer Segments
- Old players companies who alredy procue product in biogas producers
- New players companies who want to become biogas market
Cost Structure
- Designers and sales
- R&D
Revenue Streams
- License fees
- Support engineering work for customer

APPENDIX 2


Key Partners
- Local sales agent
- Component suppliers
- Assembly and site work
- Engineering cooperation
- After sales service
Key Activities
- Component purchase
- Engineerign, desgin and sales
- Project management
- R&D
Key Resources
- Designers, project managers and sales person
- Technology and brands
Value Proposition
- Decrease energy and operational costs
- Quick start of production
- Maximize production output
- Minimize maintenance costs
- Decrease the total risk
Customer Relationships
- Personal and dedicated interaction from start to end
Channels
- Trade fair and conference
- Sales person's direct contact to customer and start to negotiation
Customer Segments
- Large biogas producers
- Biogas buyers and mixers
Cost Structure
- Component purchase
- Designers and sales
- R&D
- Assembly and site work
Revenue Streams
- EPC contract

APPENDIX 3

Questions for the producers

1. Miten näette biokaasun tulevaisuuden ja mahdolliset käyttökohteet?
2. Minkälainen profiili biokaasulla on yrityksellenne? Mitä lopputuotetta yrityksenne haluaa valmistaa?
3. Onko mietitty tuotannon laajentamista?
4. Onko mietitty mahdollisuutta jalostaa biokaasusta nestemmäistä?
5. Olisiko yrityksenne kiinnostunut LBG tuotannosta jos oikeat partnerit löytyisivät? Olisiko kykyä investoida?
6. Miten iso investointi saisi olla LBG tuotannon aloittamiselle, jos asiakaskunta olisi olemassa?
7. Minkälaisia asioita arvostaisitte nesteytyslaitostoimittajalta?
8. Minkälaisia palveluita haluaisitte nesteytyslaitostoimittajalta?
9. Mitä tapahtuisi jos tariffit otettaisiin pois? Vaikuttaisiko se teidän toimintaanne?
10. Kumpaa toivotaan enemmän? Parempaa investointi tukea vai tariffi järjestelmää?
11. Mitkä ovat LBG:n mahdollisuudet, vahvuudet, heikkoudet ja esteet? Mitkä ovat esteenä biokaasun nesteytykselle liikennepolttoaineeksi teidän mielestä?
12. Kilpailutilanne bioetanolin ja biodieselin kanssa? Onko jokaiselle tuotteelle oma segmentti teidän mielestä?
13. Montako nesteytyslaitosta Suomessa voisi olla 10 vuoden kuluttua? Tai nesteytyskapasiteetti?

Questions for the other

1. Miten näätte biokaasun tulevaisuuden? Minkälainen potentiaali sillä on Suomessa? Muualla maailmassa?
2. Minkälainen rooli biokaasulla tulee olemaan sähkön- ja lämmöntuotannossa? Liikennepolttoaineena?
3. Mitä Suomessa pitäis tapahtua jotta biokaasun tuotantoon investoitaisiin enemmän? Mahdolliset poliittiset kannustimet?
4. Minkälaiset partnerit olisi tärkeitä, jotta biokaasu tuotantoa saataisiin lisättyä ja investointeja käyntiin?
5. Mikä on teidän näkemys biokaasun nesteyttämiselle? Onko kysyntää bioetanolin ja biodieselin ohella?
6. Mitkä ovat LBG:n mahdollisuudet, vahvuudet, heikkoudet ja esteet? Mitkä ovat esteenä biokaasun nesteytykselle liikennepolttoaineeksi teidän mielestä?
7. Kilpailutilanne bioetanolin ja biodieselin kanssa? Onko jokaiselle tuotteelle oma segmentti teidän mielestä?